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LEGISLATION AND LAW.—NO. III.

By T. J. C.

In this final number of the series it seems proper, as a conclusion to the foregoing numbers, that the matter of capitalization should be considered, since it is upon the capital representation that the charge for a commodity must largely rest, provided a fair return to the investor is to be allowed. The conclusion of the preceding sentences may seem puerile, but its weakness in that sense is certainly no less than that of the legislature fiat which declares that the price of a commodity shall be so much, irrespective of the knowledge that the manufacturers and sellers of it have not been consulted with as to primal costs.

Even in the instance of the occupying and using of actual real estate for manufacturing purposes on the part of the Consolidated Gas Company the valuation for fair capitalizing is a complex matter. True, the physical sites are there, and as used can be fairly gotten at as to value, but it is also a fact that the sites, if used for other purposes, would be vastly more valuable were the works of the Company not built upon the said sites. In at least two situations of branch plants of the Company, were its works leveled and the locations used for buildings suited to other lines of trading, the actual value of the land would be increased at least ten-fold over its present actual value. It may be said that this cuts no figure in the current valuation for capitalization *per se*, but it does, and the taxing authority is not slow to take advantage of the same for assessment purposes. Hence, we have in the heart of this city large areas of land covered by gas manufacturing and storing stations, each lot of which, of the dimension of 20 feet by 100, is assessed in the thousands. The nature of the trading must be an essential here.

A city must have gas works to supply the needs of its inhabitants, and for its actual physical use land costing $100 for each plot mentioned in dimension above would be just as useful as, for instance, the plots owned by the Company on West 41st and 42d streets, or on 65th and 66th streets, or on 98th and 99th streets; and many more. The exigencies of the occasion originally required the pre-empting of those situations, but the growth of the city has been such as to put the situations out of the reckoning as suitable ones for sustaining gas plants, if one will. And the further main point to be here remembered is that if the gas plants were leveled and the sites put in condition for current building uses the value of the land would be vastly increased. According to the Master's report the value of the land, etc., owned by the Company for its use in New York city amounts to $13,861,000. But suppose the structures on the land were all leveled and the bed made ready for business or residential structures? Does anyone doubt that under the latter conditions the value returned therefor would be trebled? And is the Company not entitled to some substantial showing for this, to put it in the phrase of the time, "unearned increment?" Master Masten, however, thus cogently refers to this phase of the subject:

"The counsel for the city has further claimed that not only is claimant not entitled as against the consumer to include in its capitalization the appreciation on its real estate, or unearned increment, but that it is to be seriously questioned whether complainant is entitled to any return whatever on its real estate investment. No argument is advanced in support of this proposition beyond the suggestion that 1 per cent. over and above taxes has been sometimes regarded as reasonable for a real estate investment, and that capital can be found to invest in real estate without expecting any return therefrom, excepting by appreciation." One might as well say to the farmer, "You must sell your corn at a figure that will yield you 1 per cent. on the cost of the ground in which it is sown!" To the writer it looks that these 1 per cent. comparisons are very much alike, even though they savor of the parabolic. Continuing, the Master said:

"There is nothing in the proof to support this contention. As regards the main proposition that the unearned increment should not be taken into account in capitalization, counsel for defendants have cited no authorities, and their arguments are not persuasive. The cases cited elsewhere clearly indicate that a public service corporation is entitled to demand a fair return upon the reasonable value of its property at the time it is being used for the public. In so far as the question of appreciation has been considered, the expressions of the courts are adverse to the defendants' position. It seems to be well settled, for example, in the water works' cases, that where capital is invested in property for the purpose of supplying a public necessity, if the property has since enhanced in value, those who invested their money in it, *like others who invest their money in other kinds of property*, are *justly entitled* to the benefit of the increased value in determining a reasonable rate of return upon the investment." All of which sounds like an exposition of lawfulness that is equitable as well as just.

To go a trifle outside of the strict pale of the matter in hand, let us refer momentarily to the acts of the taxing authorities of Queens

LIBRARY OF CONGRESS. AUG 12 1907 SMITHSONIAN DEPOSIT.

county, N. Y., in respect of their action in the property of the Astoria Light and Power Company at Wolsey's Point, or Astoria, L. I. When the Astoria incorporation, which to say the least is closely allied to the Consolidated Gas Company, acquired possession of its real estate located there, the situation was one that was a reproach to the vicinity. Creeks, which ran through submerged lands, were carrying on their turbid waters natural and artificial matters that could easily, and more than likely did, breed disease. Swamps, and again rocky seams of upland, were frequent within the boundaries of the site secured. In fact, it could only be seen by the trained eyes of the cultured engineer that this seemingly chaotic mess could, by the expenditure of great energy and vasts sums of money, be whipped into shape for the Company's ultimate purpose. Years after the purchase and acquirement were made the swamps and marshes were reclaimed, the rocks were cut out, the hills were leveled, the shore line was defined and bound by masonry and timber. In fact, the completed site was as its owners wished, as they planned. But, did the Queens county and the New York city taxers remain idle as to values for assessment? Not much! With every acre of ground that was put in shape for useful purpose so did the assessments grow, and still the authority, be it State or city or county, would declare to the owner in fee of all this no increment shall accrue. Well did Master Masten say, "The defendants have cited no authorities, and their arguments are not persuasive!"

So much for the real estate end of the contention, and as it was with that branch of the arguments of the authorities so was it with the contention that the franchise portion of complainant's assets was not fit subject for capitalization. As this was referred to in the first article of this series it will be sufficient here to note the Master's report (P. 81, Sec. 321) has this to say in that respect, regarding how the State Board of Tax Commissioners arrived at the "appraisement of the intangible element of the special franchise"—which seems to us clear proof that the franchise value is certainly an element, and a primal one, susceptible of capitalization:

"On the other hand, the valuation of special franchises had never been attempted before, but presented a new field of action and called for the exercise of new and different functions. They could not be seen, handled, measured, weighed or counted. They were specialties, and had no market value. There were no sales to guide and no experience from ownership, rental or use to rely upon. The new property is real estate in name, but not in reality, for it is a mere privilege to do something in public streets and places not permitted to citizens generally. While local in a narrow sense, it is unconfined in its real nature, for it depends largely on the *earning capacity* of a going concern, frequently, with several special franchises, but with *no means of determining the amount earned by each.*"

"'This method was followed in the recent case of the *People ex rel. Brooklyn, Queens Co. and Suburban R. R. Co.* vs. *The State Board of Tax Commissioners* (New York *Law Journal*, Mar. 5, 1907), in which Mr. Martin Saxe, the referee appointed in *certiorari* proceedings to review the special franchise assessment of the relator, held as follows: "Now we are called upon to consider the two elements composing a special franchise under the tax law of this State, and they are, first, the tangible property in connection with the operation of the franchise, and secondly, the intangible property, that is the right to operate conferred by the franchise grant. The total value of these two elements makes up the value of the special franchise.

"'*According to the foregoing method for estimating the value of a franchise we must first find the gross earnings from operation and deduct from that item the cost of operation, thus reaching the net earnings; and from the net earnings there should be deducted an allowance for a fair return upon the value of the tangible property, and this final sum is then capitalized at an arbitrary rate per cent. to ascertain the value of the intangible right under the franchise grant.*'"

In taking leave of this subject for the present we are impelled to the remark that never in the history of litigation, involving vital things and vast interests, has greater dignity been shown, or closer obedience to the law been seen. Every step taken in the momentous march to a legal solution of the counterpoints involved was taken with deliberation. Its managers and its counsel, without exhibition of anger or display of weakness, worked in harmony to the end that the law should have its sway, and the mental (and physical) labor involved in the preparation and presentation of the Company's case may not be estimated; great in both instances it surely was. That it was well done may not be gainsaid; and no matter what the final outcome as to itself shall be, the Company has rendered to the gas industry of the United States a service the value of which cannot be estimated from a monetary point of view.

CURRENT COMMENT.—

THROUGH Mr. Henry I. Lea, of Chicago, the contracts covering the new gasholder and the steel purifiers, with valves and yard connections, for the new plant at Bessemer, Ala., have been placed with the Isbell-Porter Company, of Newark, N. J., and the Cruse-Kemper Company, of Philadelphia.

WE have been advised of the death of Mr. Joseph Krumholz, for many years Secretary of the old Buffalo (N. Y.) Gas Light Company. Our informant was unable to give the date, but stated that Mr. Krumholz passed away early this month at his home in Buffalo. Mr. Krumholz was not far from his 70th year, and in his time was a prominent factor in the gas industry of New York. We hope to give next week some account of his life.

Incandescent Gas Lighting, with Special Reference to Inverted Burners.

[A paper read by MR. HAROLD E. COPP, of West Bromwich, England, at the June Meeting of the Institution of Gas Engineers.]

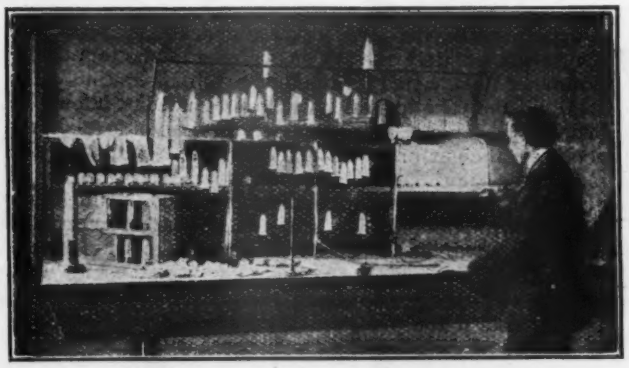
Though little more than 20 years have elapsed since Welsbach's great invention began to be practically applied, incandescent lighting has developed with such rapidity, and has attained such a remarkable degree of popularity, that the subject must now be regarded as one of the most important connected with the industry. It is therefore with no small amount of diffidence that the author ventures to approach such a subject - realizing, as he does, the impossibility of dealing completely with its many phases within the limits of an ordinary paper. There are, however, certain features which, perhaps, appeal more especially to the gas engineer; and though upon many of them there will doubtless be great variation of opinion, the author would, at the outset, ask the members to accept his assurance that in the collection of information, and in the conducting of tests and experiments for the purposes of this paper, he has observed the strictest impartiality.

On looking through the extracts from patent specifications, published from time to time by the technical journals, it will be observed that gas engineers have contributed their full share of inventions relating to the manufacture and distribution; and as the result of much ingenuity and most careful investigation, a standard burner has been produced for the testing of all grades of gas. Yet it is singular that comparatively few specifications relating to the practical use of gas for lighting purposes bear the names of members of this profession. The subject, however, judging from the extraordinary number of inventions relating to it, seems to exercise a great fascination for some people. Unfortunately, a large proportion of the inventions appears to be superfluous; and the process of attempting to discriminate between those which are likely to be useful and those which are not, is necessarily a long and tedious one. It will not be denied that numbers of incandescent burners have been placed on the market which must have had an injurious effect upon the industry; nevertheless, the attention which is being given to the matter by writers and inventors is an extremely hopeful sign, and will doubtless be productive of beneficial results.

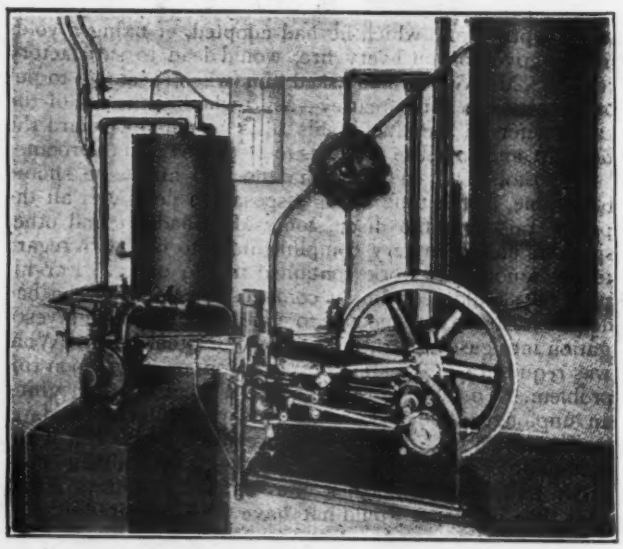
The charts showing curves of the efficiency of a few of the burners most popular in the United Kingdom indicate great variations and prove how necessary it is that those who are responsible for the welfare of the industry should be in a position to recommend to consumers the best burners and mantles for the particular purpose for which they are reqnired. There are four ways by which still further progress may be made: Firstly, by attention to the conditions of supply; secondly, by improvements in burners; thirdly, by the selection of the most suitable mantles; fourthly, by having a perfectly organized and efficient system of maintenance. The great bulk of the gas manufactured is still used for lighting—most of that lighting being obtained by means of the incandescent mantle; and it is only by continued efforts that a time will come when illuminating tests will be abolished and other tests substituted relating to the heat carrying capacity of the gas and its illuminating value when used with an incandescent mantle.

It is doubtless due more to the introduction of improvements in incandescent lighting in general, and that of the inverted burner in particular, than to the competition of electricity, that the quantity of gas manufactured in the United Kingdom has not increased during the past few years in quite the same ratio as in former years, and that in many towns the output has been seriously decreased. If, however, this can be attributed to such improvements in the uses of gas, the effect can only be temporary, and must, in the long run, prove beneficial. In West Bromwich the substitution of incandescent lighting by inverted burners for flat flame burners in churches, public buildings and factories has in many cases effected a reduction in the consumption of gas varying from 50 to 75 per cent.

Somewhat similar conditions will, in all probability, be observable in the electrical industry, consequent upon the introduction of metallic filament lamps, which can now be obtained at very low prices, and which develop more than double the amount of light from a given quantity of electricity than can be obtained from a carbon filament lamp. But little reassurance will be found in the reflection that present day voltages are unsuitable for these lamps, or that the supply of metals - such as tantalum, tungsten and osmium—is too limited to have any far reaching effect; for doubtless these are only temporary difficulties. The fact, which the author has proved by experiment,



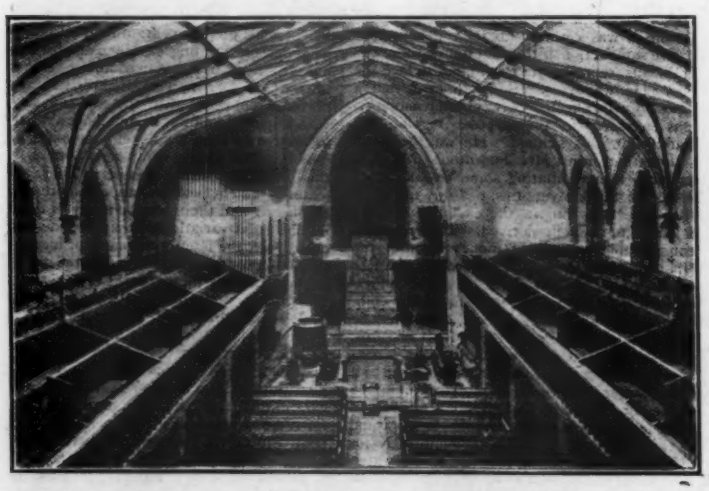
Burning Off an Seasoning Mantles at West Bromwich.



Apparatus for High Pressure Lighting or for Burning Off Mantles.

that the tantalum lamp will work for a reasonable length of time with an average expenditure of current not exceeding 1.8 watts per candle power, should be sufficient to stimulate the efforts of those whose opportunities are the greatest for the improvement of gas lighting.

Recent developments in incandescent lighting demand continual attention to the conditions of supply. Few inverted gas burners will



Christ Church West Bromwich. Lighted with Inverted Burners Controlled by Switches. Photograph Taken by Gas Light Only—15 Minutes Exposure.

work satisfactorily with less than 15-tenths pressure. Moreover, it is necessary that the pressures in the district should be more constantly maintained than formerly, and in towns where the mains are overworked much benefit will be derived by taking charts of the pressures in various portions of the district (say) once a fortnight, and adjusting the works' pressure with the object of reducing variation to a minimum.

Mr. Victor A. Rettich, in his paper before the Illuminating Engineering Society in New York, in March, 1906, asserted that inverted burners were unsuccessful in that city, and that Fire Insurance Companies demanded higher premiums for buildings in which they were used, on account of the dropping of particles of incandescent carbon. This state of affairs is probably accounted for by the fact that the gas supplied in New York is credited with an illuminating power of 23 candles, and is distributed at a pressure of from 10-tenths to 15-tenths conditions which preclude the use of nearly all the low pressure incandescent burners at present obtainable. The use of water gas also has an important bearing upon the subject; and as this gas requires less air for its combustion than ordinary coal gas, it will be a growing necessity that fairly constant proportions be maintained – inverted burners being particularly susceptible to every variation in the composition of the gas.

Passing on to the consideration of low pressure burners, the ideal burner is one in which sufficient air is injected and mixed with the gas for its complete combustion, as from this flame the maximum temperature would be developed. But, in practice, at any rate with vertical burners, it is only by forcing the mixture through a small orifice at a high velocity, that these conditions can be approached.

M. Clamond invented an inverted burner in 1905, in which, after it has become thoroughly hot, and has attained its normal condition of working, he claims to inject practically the whole of the air necessary for the combustion of the gas before its ignition. Three-and-a-half parts of cold air are injected and mixed with the gas; and, at the point of ignition, three more parts of heated air are projected into the mantle with the flame. M. Lecomte obtained more than 40-candle power per cubic foot from this burner.

Of vertical burners, the Kern burner, shown on Drawing No. 3, still maintains its supremacy, and is probably as nearly perfect as a low pressure burner can be made. The Bandsept burner (Fig. 5), which is now used extensively in Paris for street lighting, also gives an excellent result. The mantles with which the tests recorded on Diagram No. 3 were made were not suitable for the burner, which is of different dimensions to those commonly used in this country, or the results would have been higher. The peculiar feature of the burner is that it has two superimposed injectors, which produce a good mixture, and the flame is highly aerated, even with pressures as low as 6-tenths.

The form of injector used in a burner bears a very direct relationship to its efficiency. It is well known that a certain quantity of gas issuing at a certain pressure from one round hole has a greater kinetic energy than has the same quantity of gas issuing from a hole of some different shape, or from a number of smaller holes. The single hole, however, is often objected to on account of the noise it produces. It was stated by Herr H. Süssman before the German Association of Gas and Water Engineers, in November last, that the force available for the injection of air varies directly with the square of the velocity of the issuing gas.

On experimenting with burners fitted with various forms of adjusters, it will be found that the highest efficiency is given by an adjuster in which the hole is maintained fairly circular in form, or in which, if there are more than 3 holes, the adjustment is made by closing them successively. A needle valve, in which the gas issues from an annular space, gives a lower efficiency. The author, prefers, however, to dispense as far as possible with the use of mechanical adjusters, and finds it generally more satisfactory, when fitting up installations of incandescent burners - especially of the inverted type—to take a record of the pressure at the point where the burners will be fixed, and to adjust them to those exact conditions in the test room before they are sent out. If this is done, very few complaints will be received, and the use of governors, which means the lessening of the available injecting power of the gas, will be unnecessary. The same course is followed in street lighting, with great advantage.

No less important than the form of the injector is the design and shape of the mixing tube, the correct form of which is well known, but is seldom applied by inventors of burners. After having found an injector which will utilize the maximum energy of the gas, some of this energy can be expended in effecting the thorough mixture of the gas and air in the burner tube. The shape of the tube, besides its effect on the mixing, ought also to some extent serve for the prevention of striking back; and this can be done by constricting the tube at a certain point, and thereby increasing the velocity of the mixture sufficiently to prevent an explosion being propagated back to the injector.

Professor Smithells, in his lecture before the Institution in 1905, stated that the theory of mantle luminosity was a difficult subject. It is certainly one which must be dealt with by the physicist rather than by the gas engineer; but as far as the latter is concerned, whether the illuminating power given by a mantle is due to catalytic

Fig. 1.

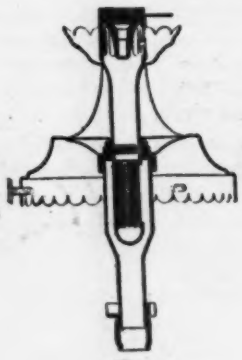


Fig. 3.

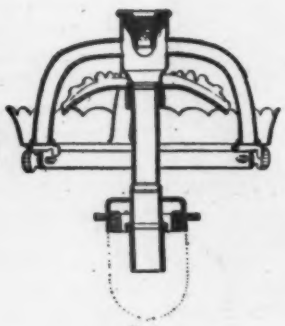


Fig. 5.

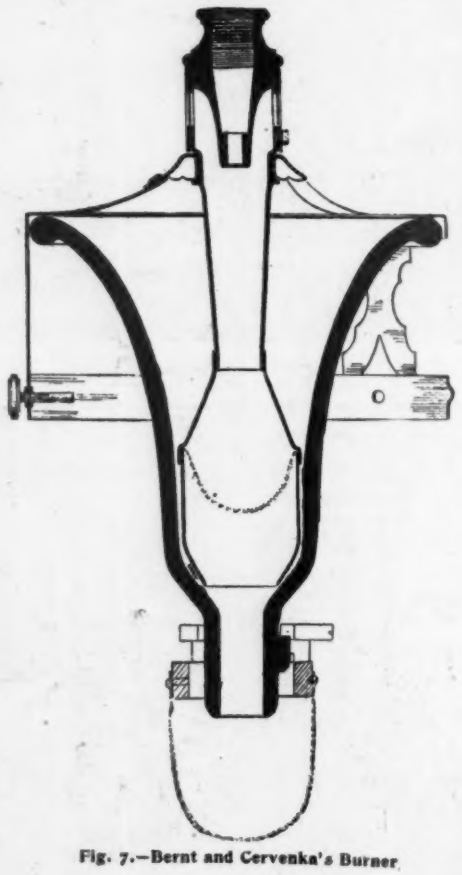
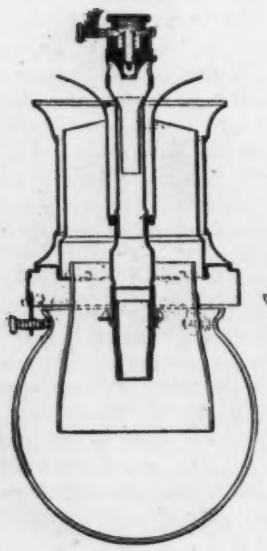


Fig. 7.—Bernt and Cervenka's Burner.



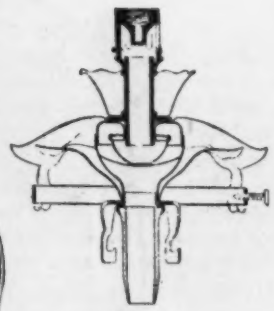


Fig. 4.

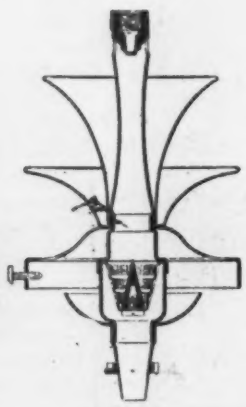


Fig. 6.

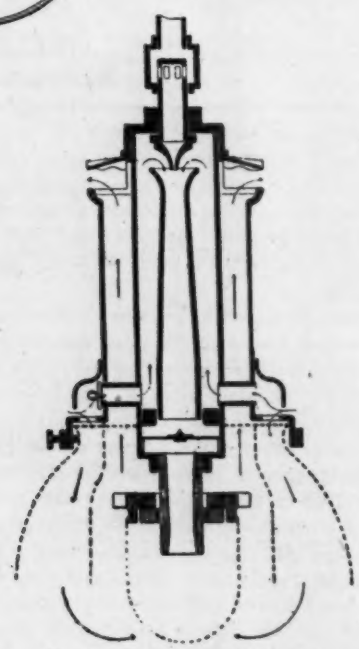


Fig. 8.—Copp's Inverted Burner.

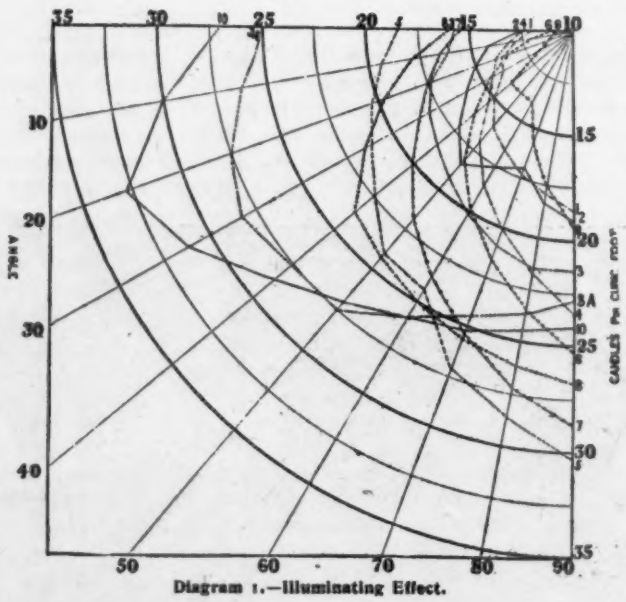
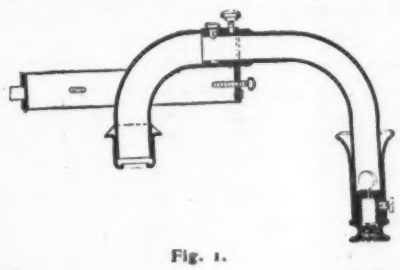


Diagram 1.—Illuminating Effect.

DRAWING NO. 1.—PENDANT BURNERS.

action or to what is now known as the theory of selective radiation, the object is to get a flame as hot as possible by effective injection and perfect mixture, and to shape a mantle of the right texture and composition to that flame—the outer zone, consisting of burning carbonic oxide and hydrogen, being the hottest. Professor Smithells found the temperature of the Bunsen flame to be 1,870° C. when fully aerated, and more than 100° C. less when insufficiently aerated; and it has been recently shown by Dr. Gray that a reduction of a few degrees in the temperature causes a great diminution in the light giving power of the mantle. Vertical burners having an arrangement for introducing a secondary supply of air under the head, and producing a hollow flame, have been tried. The author has, however, found them to be generally unsatisfactory, as the secondary air is not mixed with the gas, and merely exercises a cooling effect on the flame.

Extraordinary as the progress of incandescent lighting has been, that of the inverted burner, in spite of the prejudice which it encountered at first, has been phenomenal; and little is now heard of what was regarded as the fallacy of attempting to burn gas in a downward direction. Professor H. Drehschmidt, in his paper before the German Association of Gas and Water Engineers, on "Inverted Gas Lighting," gives the results of his very valuable investigations, which clearly show what an important effect the future of this system will have upon the gas industry. It is only just over 7 years since the first inverted burner of Messrs. Bernt and Cervenka was placed on the English market. It was formerly thought that the first necessity of an inverted burner was that the tube should be as perfectly insulated as possible, either by the use of some non-conducting material or by a metal sleeve arranged to act as an air-jacket. It has, how-



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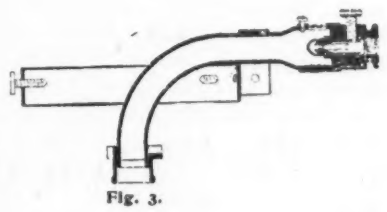

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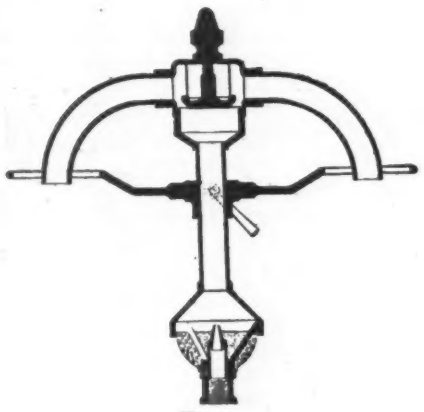


Fig. 5.

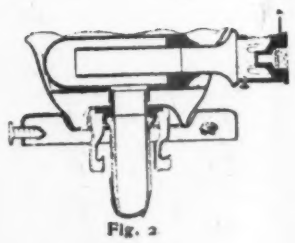


Fig. 2

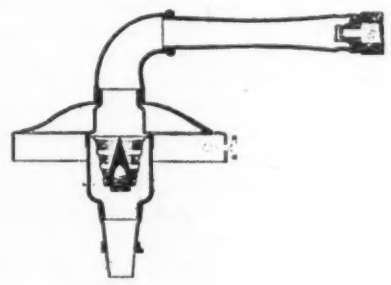


Fig. 4.

DRAWING NO. 2.—ANGLE BURNERS.

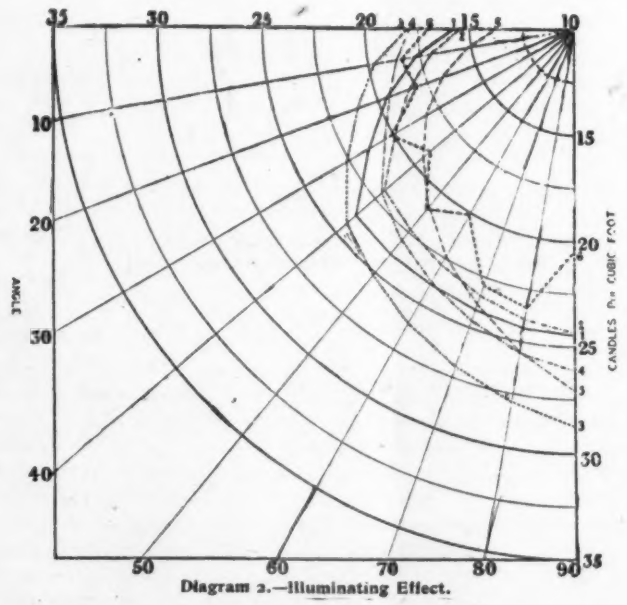


Diagram 2.—Illuminating Effect.

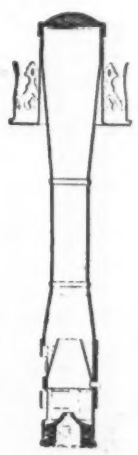


Fig. 1.

Fig. 2.

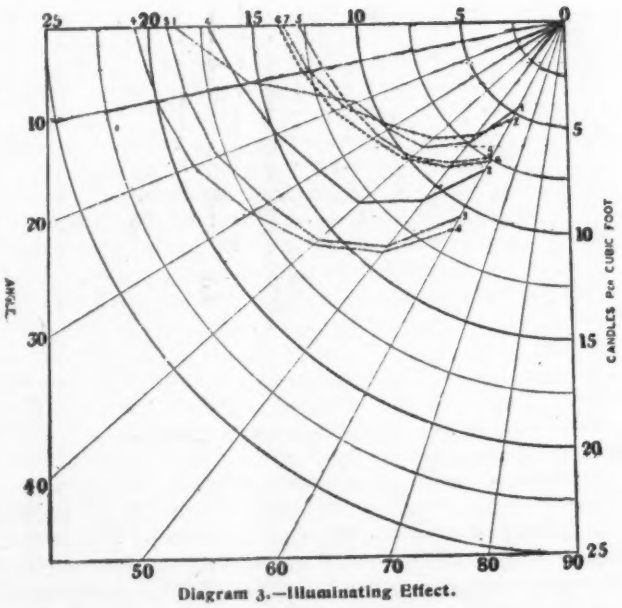


Diagram 3.—Illuminating Effect.

DRAWING NO. 3.—VERTICAL BURNERS.

ever, since been amply demomstrated that it is only really necessary to have the tip of a burner constructed of non-conducting material.

Inverted burners may now be divided into two classes; the one having for its object the insulation of the burner tube, and the other the utilization of the facilities which inverted burners present for the pre-heating of the gas and air. The most notable form of the first class is the latest pattern of Messrs. Bernt and Cervenka's burner (Fig. 7), which, it will be seen, gives a high efficiency. Metal tips are objectionable, as the heat conducted by them from the burner often causes some of the gas to be partially carbonized before reaching the flame; the result being incomplete combustion, causing the blackening of the top portion of the burner or of the ceiling above it, and, in some cases, an objectionable smell. Burners having this defect can often be made to work well by substituting a nozzle composed of either steatite or clay.

The chief drawback with most burners whose tubes are well protected from heat is that the character of the flame differs so much when cold and when hot. If it is to be satisfactory when the burner is hot, the flame is so much over-aerated when lighted that it is liable to strike back. As the burner gets hot, however, it becomes less atmospheric, owing to the decreased tendency of the heated mixture in the tube to descend. The application of the principle of regeneration is thus limited; and, if accompanied by serious diminution of the aeration of the flame, it is much better dispensed with.

It is an advantage that a burner should attain its normal condition of burning as soon as possible after being lighted, and with this object in view, the author has designed a burner (Fig. 8) in which the tube is inclosed in a chamber through which the primary air reaches the injector; so that, as it becomes hot, the tendency of the mixture to descend is lessened, and that of the primary air is correspondingly increased. In practice the flame of this burner remains nearly as atmospheric when hot as when first lighted, and the inner cone does not perceptibly lengthen, the heating of the mixture giving it a high efficiency. It will be also noticed that the lower part of the burner tube is larger in diameter than usual, to allow ample room for the mixture after being expanded by the heat, and that the orifice of the

burner is specially designed to impart the desired shape to the flame. Another advantage which it possesses, in common with some others, particularly No. 5, is that the primary air cannot be contaminated by the products of combustion. [A curve of the illuminating effect will be seen on drawing No. 1.] The author has found it advisable not to fix any inverted burner if, after it has been lighted for (say) a quarter of an hour, the inner cone is more than two-thirds of the total length of the flame. Mr. F. J. Litle, of New York, has designed a burner with a thermostat introduced into the tube for the purpose of auto matically regulating the air supply as it becomes heated.

In the working of inverted burners, it will be found that most of the complaints are caused by particles of solid matter from the pipes being carried forward by the gas into the injector. Consequently it is advisable, where possible, to fix a suitable dust trap, especially if a distance lighter is used. In a new burner invented by Mr. George Helps, of Nuneaton, there is an ingenious device whereby the injector (which has a ground joint) can be easily removed for cleaning purposes. All inverted burners should have a suitable canopy or deflector fixed at the top, preferably as a part of the burner, in order to diffuse the heated products of combustion, and prevent them from impinging directly on the ceiling. Aluminum is the best metal for this, being less liable to discoloration than others commonly employed.

The blackening of ceilings attributed to inverted gas burners is often due to the use of a by-pass. All by-passes, after descending to the point at which the particular burner is found to light best, should be turned up, and fitted with a steatite tip. A large number of inverted burners which were disposed of in West Bromwich shortly after they were introduced some 5 years ago, were apparently made for gas with lower illuminating power than that supplied, and caused so many complaints of smell, and the blackening of ceilings and fittings, that it was found advisable to exchange, free of cost, the original burners for others of a cheap but fairly efficient form; and this course has been amply justified. In the lighting of churches and public buildings with inverted burners, there is risk of the globes or shades dropping, due perhaps to a small hole in the mantle allowing the flame to play on the glass. Where this danger exists, the author makes a practice of inclosing the globes and shades in a network of fine nickel wire.

With regard to the various methods of intensified lighting, the self-intensifying system does not appear to have made any very marked progress recently, depending, as it does, entirely on the length of chimney for its efficiency. If this is unduly increased, the lamp becomes unsightly; while the chimney gives the flame such a high velocity, and elongates it to such an extent, that if a certain length of chimney is exceeded, the efficiency decreases. The wear and tear on the mantles is also heavy, and double mantles cannot be used with these lamps, as the interstices do not allow the flame to escape with sufficient rapidity.

The various systems in which the gas or gas and air is compressed may now be divided into two classes – the one working with a pressure of from 8 to 15 inches, the other with a pressure of from 40 to 54 inches. Opinions will differ as to which is the better from all points of view. The author's experience is, however, that the higher pressure gives the more satisfactory result. Another system is one in which the gas is compressed to 4 inches, and is mixed (previous to ignition) with two parts of air, or to 10 inches, and mixed with one part of air.

The primary necessity of compressed gas systems is undoubtedly simplicity. The systems working with pressures up to 15 inches can be operated very conveniently by town water pressure; and, for those using higher pressures, a rotary blower will be generally found simpler and cheaper than a reciprocating pump. Those involving the compression of gas or air, however, will not be generally adopted until the plant is much simplified and cheapened. The author has employed a small rotary blower, working at 2 pounds per square inch, and driven by means of an electric motor or small gas engine, and has found this method very cheap and efficient; the only apparatus required being a valve for automatically returning the surplus amount of gas, which also acts as a pressure regulator. Adjustments from 10 to 100 inches can be quickly effected, by means of a thumb-screw on the valve; and the pressure is indicated by a mercury gauge.

Various lamps have been constructed with a thermopile operated by the waste heat, connected to a motor in the base of the lamp, for impelling the gas forward to the burner. No lamp, on this principle, however, appears to have yet attained any large degree of popularity. There is another system, which will probably become more popular in the future – namely, that in which the air is compressed instead of the gas. Mr. Scott-Snell utilized the principle by constructing a lamp, the waste heat of which operates an extremely ingenious automatic pump fixed in the top of the lamp. In another application of the same principle, the air is compressed to 2 pounds per square inch, and is delivered to the lamps through pipes. The air can be used in a special nipple, arranged to inject an increased volume of air with the gas, which may be at a very low pressure. A portion of one of the main streets in West Bromwich is lighted on this system. A volume of air equal to that of the gas consumed is compressed to 2 pounds per square inch, and delivered to 14 lamps through a ¾-inch pipe. The apparatus, consisting of a rotary blower, driven by a small water motor, is fixed in a chamber beneath the pavement; and the air pressure can be arranged to turn the gas on, so that is is only necessary to start the motor in order to light the lamps.

Another application of the principle is that in which all the air necessary for complete combustion is delivered inside the lamp. The air so delivered having been previously filtered, the interior of the lamp remains clean for long periods, and it may be used in very dusty situations. The author has had this system at work in the retort house at the West Bromwich gas works with highly satisfactory results, and there are also other installations at work in the town.

Various high pressure systems were tried for the lighting of the tramway routes. It was necessary, however, that, as the lamps were to be attached to the poles, they should be of the "arc" pattern; and it was found impossible to obtain lamps of this type suitable for high power units, which were perfectly ventilated and storm proof. The system was abandoned, therefore, and small inverted burner lamps were eventually adopted. With regard to the burners for high pressure lighting, it will be generally found that the simpler their construction the better will be the results obtained; the only necessity being a large chamber containing gauze for insuring a proper mixture of the gas and air. Several types of inverted burners can be utilized for high pressure gas, by fitting them with a smaller injector, and attaching a nozzle to impart the correct shape of the flame.

As a result of practical experience with the most of the high pressure systems, the author is of opinion that, unless they are maintained and supervised by the gas company, they will usually be found unsatisfactory. Some records of the illuminating power and efficiency of the various systems above referred to will be found in the Appendix. The tests were made with a photometer bar 15 feet in length, and the 10-candle Harcourt pentane standard. Though the illuminating power developed by the compressed mixture of equal parts of gas and air was obviously the highest, it was found impossible to obtain a test, as the high temperature developed melted the top of the burner.

In conducting the laboratory tests of incandescent burners (which will be found recorded in the Appendix) many difficulties were encountered. First, it was impossible to get one globe, or one type of globe, to fit all the burners. The burners having the ordinary 3½-inch gallery were all tested with a plain conical globe, the top portion of which was of opaline glass, and set at an angle of 45°. Other burners could only be tested with globes with which they were supplied, so that due consideration must be given to this point when comparing the tests. In cases where the burners were not provided with an adjuster, they were first tried without mantles, and the consumption adjusted. After the mantles were fixed, they were tried at various pressures up to 20-tenths, in order to ascertain at what pressure their efficiency was the highest. Excepting in Nos. 10 and 3A, greater pressures than 20-tenths were not used, as they are seldom available at the consumers' burners, at any rate in provincial towns. The burners were then tested at all angles from the horizontal to the vertical.

The curves clearly show the difference in conditions which is brought about by the use of inverted burners. Whereas lighting from the walls of a room was best with vertical burners, lighting from the ceiling is much more advantageous with inverted burners; and it is this feature which makes the latter admirably adapted for the lighting of factories, where there are large numbers of machines. For domestic use, however, for the sake of appearance, the lighting of the top portion of a room should not be altogether neglected. It will be noticed that the burners in which a central glass ring is used in conjunction with a globe having no opening at the bottom, give a high result; the illumination of the mantle being much more intense, owing to the air being more or less heated before coming into contact with the flame. In conducting the tests, the author has been much struck with the variation in the translucent properties of opaque glass. Globes of this material produce a pleasing effect; and

some which absorb no more than 15 per cent. of the light, and through which the outline of the mantle is hardly discernible, can now be obtained. It will be observed that elbow burners are not generally as efficient as pendant burners.

The whole of the tests, excepting those of the large units, were made on a 60-inch bar, with a 10-candle Harcourt pentane standard, and a Simmance and Abady "Flicker" photometer. The standardization of globes and mantles, and methods of testing, would be extremely desirable; but the author confesses his inability to suggest any means of bringing this about.

Although many minor improvements have been effected in the manufacture of incandescent mantles, and those now obtainable are much more reliable than formerly, there is still great room for improvement. It is satisfactory to learn, however, that a new mantle, which is the result of the researches of Messrs. Plaissetty and Bruno, will shortly be obtainable. The mantle is manufactured under a new process, and is claimed to be more or less plastic, so that the risk of fracture is minimized. The Plaissetty soft mantle has been known for a considerable time in this country and possesses many advantages. Not the least is that it shapes itself to the flame, and not being burned off and collodionized in the same way as the cotton or ramie mantles before reaching the consumer, there is less liability to damage in transit. The mantle, as at first produced, sometimes shrank excessively on being ignited; but this difficulty has now, to a large extent, been overcome. The author has found it profitable to obtain uncollodionized mantles for maintenance and street lighting purposes, and to provide a small plant for burning them off. This plant consists of a gas engine driving a rotary blower, similar to the arrangement used for high pressure lighting. The gas is used at pressures varying from 2 to 5 pounds per square inch; and mantles can be burned off to any desired shape to suit different kinds of burners.

In conducting photometrical tests of various mantles, it will be found that the relationship of the mesh of the mantle to the character of the flame, is an important factor. A slow and sluggish flame generally gives the best results with an open mesh mantle, although one of close mesh very often conveys to the eye the impression of giving more light. There are burners and mantles on the market which make full use of this illusion.

The author's experience is that the maintenance of inverted burners is much less costly than that of vertical burners; and in many places where a large number are in use, they can be profitably maintained at a yearly cost of 1s. per burner. The following table gives the mantles used on the various classes of maintenance in West Bromwich:

Mantles Used for Maintenance.—From October, 1906 to March, 1907 (inclusive).

Type of Burner.	Situation.	Description of Mantles.	Mantles per Burner.
*"B" Inverted (square lanterns).	Street Lighting.	Collodionized.	3.10
*Inverted (arc pattern lamps).	" "	"	2.80
*Inverted (3 burners per lamp).	" "	"	3.35
"C"	" "	"	5.90
"	" "	"	5.77
Inverted.	" "	Uncollodionized.	4.10
"C" and Kern. Inverted.	Shops and Residences.	Both.	3.25
"	" "	"	4.40
"	Churches.	Uncollodionized.	1.78
"	Schools.	"	2.20
"	"	Collodionized.	5.20

* Lamps fixed on tram poles; mantles consequently subjected to severe vibration.

The difficulties connected with the ignition of burners are, perhaps, more than anything else, retarding the progress of gas lighting at the present time. The pilot jet, in spite of its many drawbacks, still remains in general use. The greatest difficulty of all mechanical systems is that a perceptible time must elapse after turning on the gas before it can be ignited. There are numerous electrical lighters obtainable; but these are all more or less bulky and somewhat expensive.

Automatic ignition by means of platinum black is not employed to any large extent in this country. There are several small igniters on this principle; but they are slow in action, and often deteriorate rapidly. If, however, they are suspended at the correct point, and the burners are kept clean, so that the flame is thoroughly atmospheric, their life is much prolonged. The author has had several attached to inverted burners, which have been in operation over 12 months. In Germany, self-lighting mantles are employed to some extent—a small pellet of spongy platinum, to which strips of ammonium platinum chloride are attached, being secured to some part of the mantle. But the mantles are somewhat expensive, and are more or less uncertain in action.

The author has successfully used a coil of fine platinum wire, inclosed in another coil of iron wire for protection from the action of the flame; the current from two dry cells being sufficient to cause almost instantaneous ignition of the gas. The platinum coil lasts for a long time; but not more than 3 lights can be operated in the same circuit. The gas is turned on by means of a pneumatic switch; and the flow of current is controlled by a bell push. The pneumatic tube is insulated with cotton, and is used as a conductor of the current; the wire being "earthed" to the gas pipe for the return. The arrangement in its present form, however, is too expensive to be generally employed.

The well-known device for turning on gas from a distance by pneumatic pressure has been found extremely useful in the lighting of churches, as well as in domestic lighting. In the case of the former, it is often desired to reduce the light during certain portions of the service; and for this purpose the author has successfully employed the pneumatic distance lighter, in one case by turning out alternate lights, and in others by turning off certain pendants. By-passes for these burners will be generally found more reliable than electrical igniters. Though the mixture of gas and air descends from 4 to 8 inches from an inverted burner before it is lighted, ignition can only be effected at a point near to the orifice. Some burners are found to light best with the pilot jet just below the ring of the mantle, and others with the jet some 2 or 3 inches above the mantle. In church lighting, after the type of burner to be used is decided upon, it is important that this should be determined by experiment, for if a number of burners failed to light during a service, the result might be serious.

There is also another system, invented by Mr. Thomas Glover, of Norwich, and two of his assistants, in which the gas is controlled by means of a tumbler switch, on the principle that when the pressure is reduced by the gas being almost turned off (only sufficient being allowed to pass to keep the by-pass alight) an automatic valve closes the main supply to the burner. When the switch is moved into the reverse position, the full gas supply is again allowed to flow through the pipes, and this raises the valve controlling the main supply to the burner. Water pressure has also been utilized for operating burners from a distance. Baron Auer von Welsbach has succeeded in producing an alloy of cerium and iron which, on being struck lightly, emits a shower of sparks capable of igniting a burner, and it is possible that by this means many of the present difficulties will be overcome.

The curves on Diagrams Nos. 4 and 5 show the results of tests of various systems of street lighting in use at West Bromwich. It will be observed that, although inverted mantles emit their maximum light in a downward direction, nevertheless, if suitably arranged, they illuminate a road very effectively. Two mantles arranged in a line at right angles to the direction of the road give a much better distribution of light than one. With inverted burners there is always the risk of a mantle dropping completely off, without previously showing any signs of fracture. When single mantles are used, therefore, it is advisable to inclose them in a fine network of nickel wire, with a clearance of about 1 inch round the mantle. If there are two or more, the appearance is much improved by placing them close enough together to resemble one source of light. The curves are plotted to show the light falling upon the ground surface in candle feet, as it is only in this way that the degree of patchiness of the lighting by inverted burners can be compared with that of vertical burners.

With a view to projecting some of the downward light from an inverted mantle along the road, a lantern way constructed having a conical reflector at the bottom, as well as at the top; and Curve C shows the improvement due to the use of this arrangement. The lantern from which Curve E was taken is similar to the above, but is only fitted with a flat porcelain reflector above the burner. The curves would, of course, have been much flatter had the light falling upon a vertical plane been plotted instead.

The tests from which Diagrams Nos. 4 and 5 were prepared were made by means of a Preece-Trotter portable photometer, which was

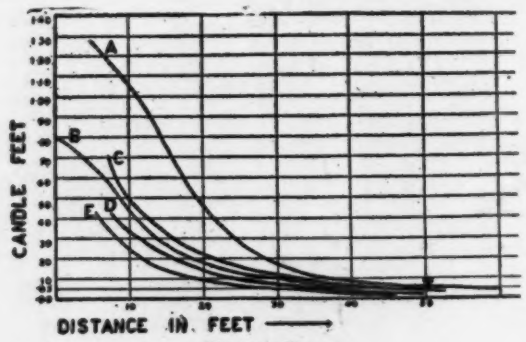


Diagram No. 4.

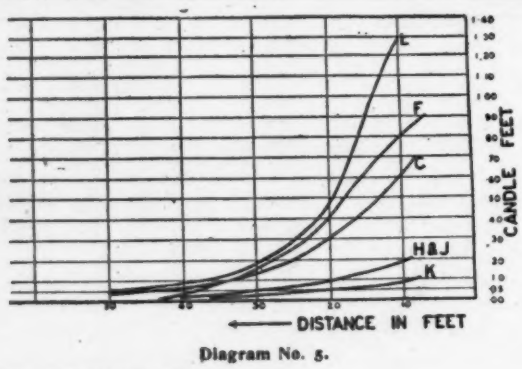


Diagram No. 5.

CURVES OF STREET ILLUMINATION.

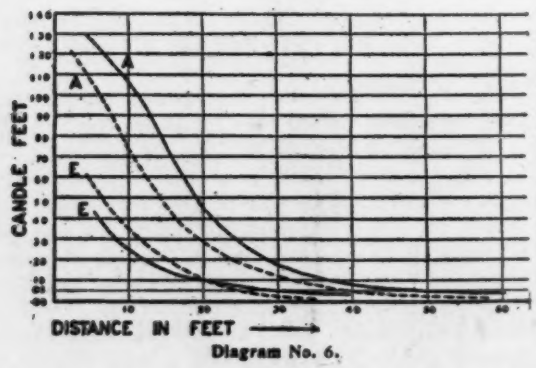
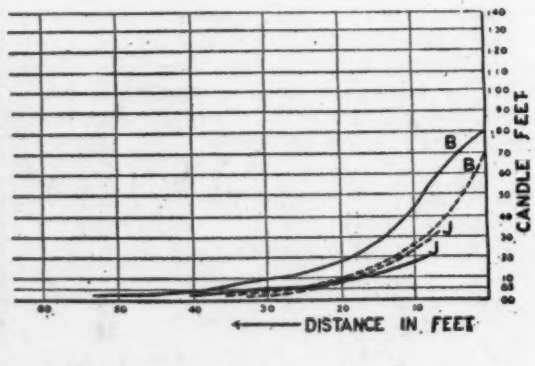
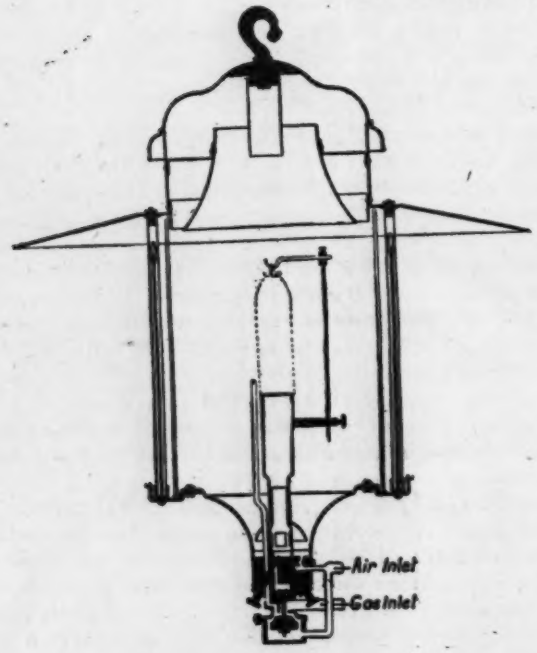


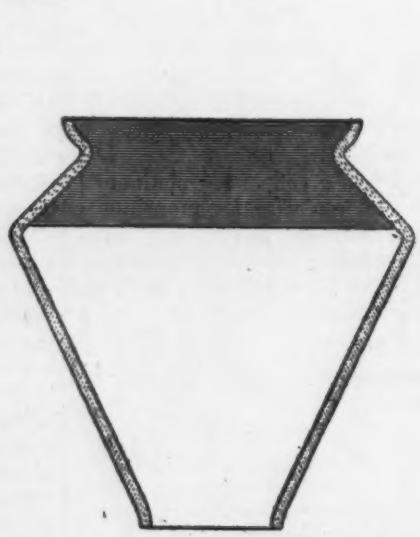
Diagram No. 6.



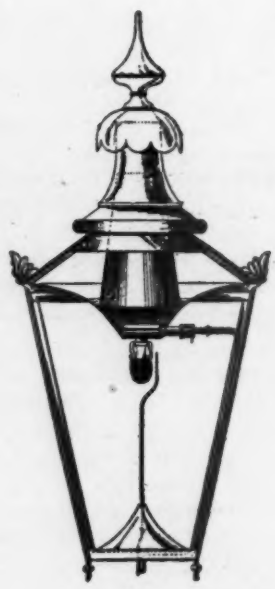
COMPARISON OF METHODS OF TESTING.



Double Inclosed Lamp Working with Compressed Air.



Opal and Flint Globe Used for Testing.



Street Lamp with Inverted Burner and Double Reflector.

described by Mr. Henry Fowler, of Derby, in his paper on street photometry before the Manchester District Association of Gas Engineers, in December, 1902, and was kindly lent by him to the author for the purposes of this paper. The tests shown in broken lines on Diagrams Nos. 6 and 7 were made by means of a street photometer, fitted with a pentane lamp, which was standardized with the flame at different heights on the laboratory photometer with a 10-candle Harcourt pentane lamp—a Simmance and Abady "Flicker" instrument being used in each case. Observations were taken at intervals of 10 feet from the base of the lamp column; and the illuminating power was calculated in accordance with the law of inverse squares. The exact distance having been ascertained by diagram, the illuminating power was divided by the square of this distance, giving candle feet, which, on being multiplied by the cosine of the angle between the direction of the light rays and the vertical or normal to the road surface, gives the light falling upon that surface.

The readings of the Preece-Trotter instrument are taken from a pointer moving through an arc, calibrated in candle feet by means of the cosine law. The variation in the results by the respective instruments is largely due to the fact that, whereas the former only shows the illuminating effect of the lamp under test, the latter receives illumination from all sources. There are also many possibilities of error in the measurement of street illumination—such as the varying reflecting power of adjacent buildings, the condition of the road surface, and the state of the atmosphere.

APPENDIX.—*Street Lighting.*—Notes referring to Curves on Diagrams Nos. 4, 5, 6 and 7.

A.—Arc pattern lamps with two inverted burners, each consuming 4½ cubic feet per hour. Fitted to tram poles on alternate sides of the road, 106 feet apart, 15 feet 6 inches above pavement. Tests taken along the curb.

B.—Arc pattern lamps, similar to "A," but having only one inverted burner, consuming 4½ cubic feet per hour.

C.—Special square lantern, with reflector top and bottom, fitted with one inverted burner, consuming 4 cubic feet per hour; 11 feet

Pendant Burners.

Burner Number	Pressure Tested at Tenths.	Consumption per Hour.	Gas Used for Testing		Kind of Globe.	Remarks.
			Illuminating Power.	Calorific Power.		
1	20	3.25	16.98	634.9	Opal and flint.	Aluminum top.
2	20	3.25	16.28	630.8	Clear, constricted in middle.	Needle adjuster.
3	20	3.90	16.60	619.0	Opaline.	No air admitted at bottom of globe.
4	20	3.50	16.21	611.0	Clear fluted.	Opal cone fixed on gallery. Flame under-aerated.
5	20	3.80	16.54	634.9	Opal and flint.	Inner cone of flame short.
6	20	3.20	16.96	624.9	do.	Tubes convey air from gallery to injector.
7	18	3.20	16.80	630.0	do.	Enamelled cup, which acts as reflector.
8	20	3.40	16.96	634.9	do.	Porcelain insulator, " "
9	20	1.55	16.81	626.5	Clear conical.	Bijou, with porcelain insulator.
3A	22	4.00	16.81	626.5	Clear optic.	No air admitted at bottom of globe. Longer mantle used; illumination at side consequently greater.
10	22	3.60	16.80	620.0	do.	

Angle Burners.

Burner Number.	Pressure Tested at Tenths.	Consumption per Hour.	Gas Used for Testing.		Kind of Globe.	Remarks.
			Illuminating Power.	Calorific Power.		
1	20	3.00	16.96	624.6	Opal and flint.	No adjuster or burner tested.
2	20	4.25	16.82	620.0	do.	
3	20	3.00	16.54	642.8	do.	Adjuster, one hole, keeps fairly circular during adjustment.
4	20	3.25	16.54	642.8	do.	Needle adjuster. Mixing chamber in burner.
5	15	3.65	16.90	634.0	do.	No adjuster. Mixing chamber in burner.
6	20	6.40	16.43	607.0	No globe.	Two mantles. No adjuster. No reflector.

Vertical Burners.

Burner Number.	Pressure Tested at Tenths.	Consumption per Hour.	Gas Used for Testing.		Remarks.
			Illuminating Power.	Calorific Power.	
1	20	4.00	16.73	610.26	Clear 6-inch chimney.
2	16	3.85	16.73	610.26	do.
3	17	2.65	16.80	612.06	Clear globe.
4	15	4.00	16.80	612.06	do.
5	18	4.90	16.73	608.42	No chimney or globe.
6	18	4.10	16.81	..	Mantle bad fit.
7	20	3.40	16.31	619.04	No chimney or globe; no gauze in burner top.

above the pavement. On alternate sides of the road, 160 feet apart. Tests taken along the curb.

D.—Square lantern with no reflector, fitted with double inverted burner, consuming 7 cubic feet per hour; 11 feet 6 inches high. On alternate sides of the road, 180 feet apart. Tests taken along the pavement.

E.—Square lantern, similar to "C," but with reflector over top only.

F.—Single inclosed 5-ampere electric arc lamp on tram poles along the center of the road, two lamps on alternate poles; 17 feet 3 inches above the road. Poles with lamps on average 240 feet apart. Tests taken along the center of the road.

G.—Self intensifying, 200-candle power, in hexagonal lanterns; 11 feet 6 inches high.

H.—"C" burners with steatite tops in square lanterns, with flat reflectors; 10 feet 6 inches high, on alternate sides of the road, 120 feet apart. Tests taken along the pavement.

J.—Same as "H," ordinary "C" burner.

K.—Electric incandescent lamps, 11 feet high. Used instead of "F," from 11 P.M.

L.—Compressed air burners. Two arc pattern lamps, 13 feet high, on each tram pole in the center of the road, 100 feet apart. Consumption, 15 cubic feet per hour. Tests taken along the center of the road.

Highest Efficiency Observed with Various Systems of Intensified Gas Lighting.

System	Consumption (Cubic Feet)	Pressure (Inches of Water).	Illuminating Power.	Candles per Foot.
Self intensifying.....	21.0	2.4	592.2	28.2
Compressed gas.....	16.0	54.0	584.0	36.5
" "	14.7	11.0	460.1	31.3
Compressed air.....	10.5	54.0	340.0	32.0

Compressed gas and air not tested

[Prepared for the JOURNAL.]

What the Motor-Vehicle has Done for Gas and Other Lights.

By "ENGINEER."

The general advent of the automobile has helped the extension of gas lighting throughout the country. Wherever there is an active motor-vehicle field there is always a good demand for lights, for lights and automobiles go together. There are several different classes under which the lighting for automobiles may be included. First, there is the increased lighting of the streets which almost always follows the advent of motorists in a section. The raceways which are erected purposely for automobile traffic are always liberally provided with gas arcs and kindred lights along the borders, and the writer observes that a great many of these specially planned sideways are in use or in process of construction in the country. The object is to get the automobile traffic excluded from the general highway. All along the edges of the motor ways through the United States, Cuba, Honolulu and other countries, one sees the evenly adjusted light posts, supporting the lights which are burned brilliantly for the purpose of shedding light along the road throughout the night. Night parties are many. Traffic is frequent. The motor ways are not only brilliantly lighted, but there are stopping places along the way where machines are repaired, tanks refilled with gasoline, tires fixed, food furnished, lodging provided, etc. All of these places are brilliantly glowing with light wherever you pass. Furthermore, there has been a development in the gas lighting business as a result of exterior work on motors. That is, in all sections where automobiles are in use there are establishments in which repairs can be made. The average automobile is a machine which requires considerable tinkering to maintain in effective running order, as is known. There must be a certain amount of adjusting, cleaning, lubricating, etc., at regular intervals, and much of this work is necessarily done in the night time, owing to the fact that many of the touring parties select the night for travel. There are touring cars in use with berths for one or more persons. These cars run at night. As a result of the rapidly

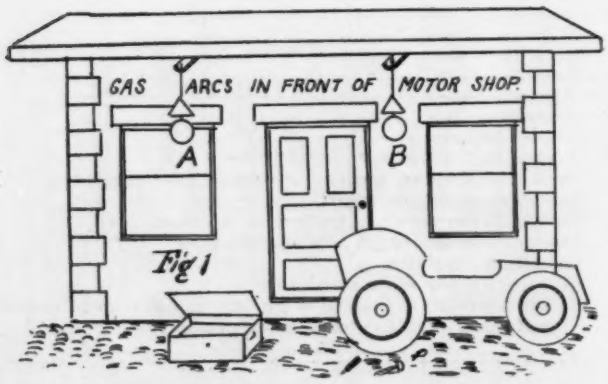


Fig. 1

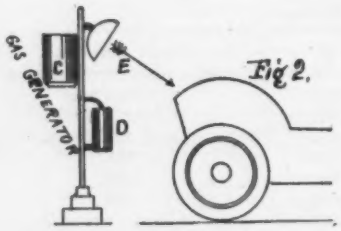


Fig. 2.

Fig. 3

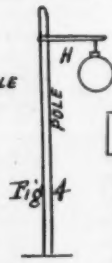


Fig. 4

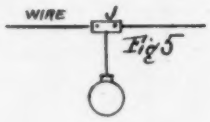


Fig. 5

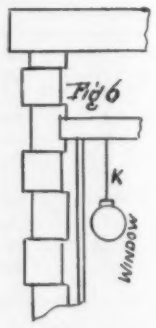


Fig. 6

developing night service, a great many repair and construction automobile resorts have sprung into existence along the motor ways. The process of lighting the fronts of these establishments involves the use of some novel fittings. I observed several different kinds of lights in use, all the way from the crudest forms of oil lights to the most brilliant calcium effects, and there are acetylene lights galore. I noticed vapor lights which were intended to produce a flame of considerable whiteness from pressure on kerosene oil in a tank. Even torches are employed; but the inferior forms of lighting, that flicker and bother, are fast giving way to the more substantial and steadier modern descriptions. The proprietor of the shop along the motor way or in the motor-vehicle infested sections of cities and large towns, necessarily seeks to use his light for three purposes. First, he must get hold of the autoists who want something done to their machines or a tank replenished or a tire refilled. Therefore, he proceeds to install exterior lighting liberally. And this matter of exterior lighting for advertising purposes is going to be the direct means of developing the gas light business to large proportions during the next few years. I notice that some of the best firms in the country are experimenting with outside lights in front of their show windows, doors and street exhibitions. The eye of the passerby is caught at night. Good advertising results. And it is just the same with the automobile repair men and the tourists' hotels and the tank fillers' stands along the motor way. As soon as anything occurs to the automobile, or as soon as oil is needed, or food or shelter wanted, a watch is kept for the lighted establishment providing these necessities. If the establishment is dark as night the autoist speeds by; but with the welcome of brilliant lights he sees and stops and patronizes the place.

Now, as to the agencies for lighting up the shops, the stands, the eating and resting houses, different schemes are, of course, employed. The writer observed a great many instances of the use of gas. As a rule there is not much electrical current along the remote highways, and the establishments seldom put in separate electric lighting installations. Hence home-made gases, or gas carried in pipes from the nearest city or town, are depended upon.

Two or three powerful arcs supported in front of a building on arms, as in Fig. 1, at *A* and *B*, provide effective light for the frontage. The practice is to have the tool outfit at hand, hence the machine can be run up into the light of the gas arcs, and as these lights furnish ample light for the work the repairing of tires or tank filling can be done. The lights as arranged are for the purpose of furnishing lights to attract notice, for lighting the road in front of the structure, and for furnishing a means for lighting the work for mechanics; but the overhead light will not light the sides of the automobile or below it, hence any work underneath might be handicapped. This trouble is avoided by having special light stands, some of which are portable and burn with lights generated from gases in special retorts.

Fig. 2 shows one light I noticed, derived by using a spot light which had been bought second-hand from a music hall. Oxylithe in cake form is placed in the retort, *C*, and it generates gas when wet. Oxylithe is made from peroxide of sodium. The hydrogen gas needed to burn with the gas from the oxylithe is made in the saturator, *D*, from gasoline. The two gases combine and burn in the jet at *E*. Then I noticed vapor lights used with flexible tubes, as in Fig. 3, so that a workman might get under a machine and scrutinize the machinery. The affair is fitted with a handle, *G*. The block, *F*, sustains the parts in harmony with the mantle. The hot mantle furnishes enough heat to vaporize the oil as the oil reached the point of ignition. Hence the oil burns with the air, under pressure as a vapor, on the mantle. The oil is fed through the tube from the supply tank. Fig. 4 shows one of the post gas arcs. These are usually set up at intervals along the motor way in the vicinity of any park, hotel or repair shop. They are the beacons to light the autoists on. An arm, *H*, supports the light out over the road. Some of the gas arcs are supported on traveling blocks, *J*, on wires stretched across the motor way, as in Fig. 5. Some are hung direct in front of windows, as at *K*, Fig. 6. The modern automobile is doing considerable towards developing the gas field throughout the country, and the future is brighter than ever.

Mechanical Draft for Government Fuel Testing Plant at Jamestown Exposition.

The valuable results obtained by the United States Geological Survey at the St. Louis Exposition, in determining the actual steam making values of American fuels, is to be continued with a similar plant at the Jamestown Exposition. The report on the St. Louis tests, which fills three large volumes, is devoted largely to fuels from the Middle-West and Western coal fields. The plant now being erected at Jamestown will give an opportunity for analyzing, testing and placing on record, in a similarly thorough and comprehensive manner, the coals from the Eastern fields. The Jamestown plant will contain three 300-horse power boilers, each equipped with an engine driven, 100-inch mechanical draft fan and a 35-foot stack, both supplied by the Green Fuel Economizer Company, of Matteawan, N. Y. The fans will be so controlled that the draft can be regulated as desired by hand or automatically. The wheels of the fans measure 5 feet in diameter by 2¼ feet width at the tips of the blades and are driven by 6 by 7-inch Green vertical, center-crank engines. The laying out of the mechanical draft plant was entrusted by the Survey to the Green Fuel Economizer Company.

New Lights and New Illuminants from the Central Station's Point of View.

[A paper read by Mr. R.. S. Hale, at the Boston Meeting, Illuminating Engineering Society.]

The new illuminants are devised by engineers and inventors and are a great advance in the art of lighting. The public in the form of customers of the central station uses the new illuminant and gets the advantage. The central station is the intermediary between the inventor and the customer. From most points of view the central station makes and sells electricity rather than light, and if the central station produces and sells its product purely as electricity, then although the result might be important, the question of the method of handling the introduction of new illuminants would be of comparatively slight importance to the central station, or rather the central siation has but little to do with it. When the central station is concerned with electricity only, it looks forward either to having the new illuminants give so much more light that they may cut down the total output of electricity, or, on the other hand, that the new illuminants may so increase the demand for light that the total output of electricity will increase; and if the central station is supplying only electricity, taking no consideration of how it is used—in other words, if the central station pursues a policy of making no lamp renewals whatsoever—then, while the central station is interested in the result, it can do but little more than to wait.

If, however, the central station is supplying lamps and including

the cost of them in its charge for electricity—in other words, is selling light—then the new illuminant comes before the central station manager in a very immediate and practical way; and in the following notes I have given some of the essential factors that cannot be ignored, and some personal opinions which, however, I do not consider final. They are merely in the way the question strikes one at the moment.

In the first place the new illuminants are an improvement, and the word itself means that the new illuminants give a greater ratio between the light received by the customer and the current sold. The immediate effect may be either that the central station sells the same number of units of electricity and the customer gets more light, or that the customer gets the same amount of light as before and purchases less electricity; and while the immediate effect must lie between these two points, yet the final result is effected by the increase in business, and may be such that even more units of electricity are used than ever before, and, of course, in such case, very much more light.

While it is possible that the new illuminants may permanently cut down the central station sales of current for light, yet this is very improbable. It is possible, for instance, that an improvement to say 50-candle power per watt would affect the central station lighting business and would be as unpleasant to the central lighting station as the railroads once were to the stage coaches. However, the final result will be the same whatever the central station does, and in my opinion the final result will actually be a very large increase of business. Any improvement in illuminants will bring in at least some competitive business. For instance, in Boston the sales of electricity amount to about $3,500,000 per year, and the sales of gas to about $3,000,000. Much of both of these is for power and heat, but even assuming that half of the gas sold is for lighting purposes, this leaves a possible competitive field open to the new illuminants amounting to $1,500,000, besides the competition with oil lighting. This should mean an income for electricity of $2,000,000 to $3,000,000 a year, since customers will pay from 25 per cent. to 100 per cent. more for electricity than for gas, on account of the incidental advantage due to electricity, such as savings in decorations, wall papers, ventilation, etc.

In addition to the competitive field there are great latent possibilities. Many customers will pay $5 a month for a certain number of units of light. They will not pay $10 for double the number of units, but they will pay, say, $10 for triple or quadruple the number of units of light. Hence, while too great an improvement in illuminants may cut down the sales of electricity, there is an intermediate point where the improvement may actually increase the sales, and the improvements that are now apparently coming are, in my opinion, about this point. An improvement from ½ of a candle per watt to 1 candle per watt, such as is now in sight, will, in my opinion, ultimately increase the sales of electricity, and it will not be until we get to 3 or 4 candles per watt that the improvements in illuminants will cut down the sales of electricity. In any case the final result will be the same whatever the central station does, and the central station should not attempt to interfere with the final result any more than the hackmen of the city should be allowed to force the railroads to have several stations instead of a union station.

Although the final result will be the same whatever the central station does, yet the immediate result to the central station that supplies free lamp renewals is a very important one. If the central station is supplying free lamp renewals and adopts the new illuminants, the immediate effect will be to give the customers more light in proportion to the money they pay; and this may either cause an immediate fall in income followed possibly by an increase, or the central station may use its influence so that from the start the sales of current will remain the same or increase, while the light received by the customer shows a much greater increase.

This is the candle power question. To-day, or rather yesterday, the central station supplied a lamp giving 16-candle power for 50 watts. If, on the introduction of the tungsten and tantalum lamps, they give 16-candle power for 20 watts, the immediate effect would be a very considerable falling off in income, and the falling off in income would be very much greater than the falling off of expense, since every central station has a large amount of fixed expense not affected by the immediate use of current.

If this were a free country and there were no socialists, a central station might wisely risk the temporary loss in income, looking to its future profits to make up for the loss, but if in this country the central station pays no dividends for one or more years, this is seldom or ever taken into consideration in the future when the question of reducing its prices comes in; hence the central station, or rather the people who have been frugal enough to save the money that built the central station, must plan to earn their dividend each year and cannot risk losing it for even a short period.

Even without this consideration, if we assume that the future result of the new illuminants is to give the public much more light for the same or more current than at present, then the central station may properly attempt to reach this good result at once and instead of giving a 16-candle power 20-watt lamp in place of its present lamps, it may offer its customers a 40-candle power 50-watt lamp at the start.

It is true that very often a 40-candle power 50-watt lamp will let a customer use two 40-candle power lamps where he now uses five 16-candle power lamps, but the public is less apt to cut down its supply of current if the central station supplies lamps of the same wattage as before, and hence it is to the advantage of both the public and the central station that the first move in the adoption of the new illuminants should be in the direction of the lamps of the same wattage as now, and of much greater candle power.

Another important part of the central station view of the question is on the cost of renewals. If the cost of renewals is small in proportion to the total cost of electricity, then a slight variation in the cost of renewals is not important. For instance, to-day a central station, such as the Edison Electric Illuminating Company, of Boston, supplies both 8 and 16-candle power lamps free. The cost of renewals of the 8-candle power lamps is slightly more than of the 16-candle power, but the difference is so slight that it can be disregarded.

One lamp company has just adopted the practice of proportioning its lamps so that the renewal cost per kilowatt hour shall be the same for all sizes. Thus it supplies, we will say, a 50-watt lamp whose proper life is 600 hours with a total consumption of 30 units, and if the cost of the lamp is 15 cents, this makes the renewal cost ½ cent per unit. If the 100-watt lamp costs say 25 cents, it would then be so proportioned for voltage, etc., that during its economical life it would use 50 units. This practice is good, but unfortunately it does not cover the whole situation, since it is desirable that lighting circuits should be so arranged that small miscellaneous devices, such as cooking devices, fans, etc., should be supplied from the same sockets, and if the total cost of renewals becomes large in proportion to the cost of electricity, it is difficult to handle the question of free renewals.

The central station, therefore, much prefers that the new illuminants should be developed along the line of lamps whose renewal cost will be small in proportion to the cost of electricity. If, for instance, the price of electricity should get down to 10 cents a unit on an average, and the renewal cost of the new illuminants should become 4 cents a unit, this would force the central station to give up the policy of free renewals.

This situation has actually arisen to-day in the case of very large wholesale customers. For very large wholesale customers burning long hours, as for instance a department store, the lamps in which are kept going all day, the cost of electricity gets down in the neighborhood of 3 or 4 cents a unit, and for such business the central stations are in general giving up the policy of free renewals. Even in the case of these large customers, however, the fact that they have to pay for the lamps in a separate charge has caused them to use lamps that are not as economical as they should be.

In the case of small customers we have just had an instance in Boston here where we put out the tantalum lamps at a renewal charge that not only made the cost per unit of light much less than for the ordinary carbon lamp, but even made the cost for the 22-candle power tantalum lamp much less per hour than for the 16-candle power carbon lamp. In spite of this fact we find that the customer objects very much more to paying an occasional 30 or 60 cents for a new lamp than he objects to paying 60 cents or $1 more every month on the bill.

The flaming arc is another good illustration of this feature. The flaming arc for outdoor lighting gives tremendously more light in proportion to the total cost and maintenance. The maintenance cost, however, is so great that the central station cannot possibly afford to include this in the price of current, so that the central stations have been forced to let the customer buy and maintain his own flaming arcs, and the results have been that the customer would rather pay a much greater total amount in the form of a bill for current than to pay the 2 charges for current and maintenance and trimming, even if the total of the 2 be less than the charge for the ordinary arcs alone.

Another part of the question that affects the immediate interests of the central station, but which will finally cancel out, is the question of investment and antiquation. Take for instance the small carbon arc lamp using carbons of $\frac{5}{16}$-inch diameter. This improves the light something like 25 per cent. as compared with the arc lamp using ½-inch carbons, but its adoption would involve purchasing a full sup-

ply of new lamps, since the old lamps using a large carbon cannot be fitted over the small carbons. This would often be spoken of as involving scrapping of old lamps, but the correct point of view is from that of purchasing new lamps. Scrapping the old lamps is merely a book entry, while purchasing the new lamps takes the money out of the pockets of the people who have saved it up. If the small carbon lamps are going to be used for 10 or 15 years, then this will furnish time enough for the saving from them to make up for their cost; but if within 2 or 3 years the tungsten incandescent lamp is going to replace all our present arc lamps, then it is cheaper to wait for the tungsten than to purchase small carbon arc lamps and use them for 2 years only.

The Nernst lamp is to-day in much the same situation as the small carbon arc lamp. So far as we can tell, it is an improvement as compared with the ordinary incandescent lamp, but it costs $40 a kilowatt, and the question is whether it will save enough in the next year or two to make up for its investment cost when the tungsten lamp is finally put into service.

Another feature that the central station has to consider very carefully in regard to these new illuminants is their great multiplicity. To-day, for instance, the Edison Electric Illuminating Company, of Boston, supplies, either free or at a nominal cost, over 30 kinds of incandescent lamps, 6 or 8 kinds of arc lamps, and 6 or 8 kinds of Nernst lamps. When the supply of any particular kind of renewal service is reasonably large, it can be handled with fairly good satisfaction, but we have the immediate problem before us to-day, for instance, in regard to the Nernst lamps in our outlying districts. If a customer in a small town, such for instance as Dover or Bellingham, wants one Nernst lamp or one arc lamp, we cannot very well afford to send a man out there especially to trim and maintain one lamp. Hence obviously it is not enough in the case of the new illuminant to say that its cost of maintenance, or renewal cost, is small when it is done in quantities. It is necessary that the new illuminant of a special kind must be quickly adopted in large quantities if it is to be adopted by the central station.

Another question that affects the central station very closely is that of deliveries. Take for instance the "Gem" lamp. I should say that the central stations were very well satisfied to-day with this lamp and feel that its cost of renewal is such that they could replace the ordinary carbon with "Gems." But unfortunately the factories cannot stop making ordinary lamps and go into making "Gem" lamps in 1 or 2 months, or even 1 or 2 years. At first the output of these lamps was 5 per cent. of the total, to-day it is something like 25 per cent., and it will be a year or two before it is 100 per cent. While the central station may properly differentiate between different classes of customers it must not discriminate. The central station, just like the telephone company or the water works, may make one price for commercial business and another price for residential business, but it must not differentiate between Brown and Smith whose business and use of current are alike. Hence the question is, "Who shall get the 'Gem' lamps and who shall use the carbon lamps during the period of transition?" This has been solved in part by making a temporary extra charge for the "Gem" lamps. For instance, the large companies to-day that formerly renewed ordinary lamps free, still continue this practice, and they also renew "Gem" lamps, making an extra charge of 5 cents only as compared with the cost of the lamp of 15 cents and 20 cents.

Apparently something like 10 per cent. to 20 per cent. of the customers are willing to pay this 5 cents extra charge. The others prefer to pay 20 per cent. to 30 per cent. more on the bill for electricity. Theoretically, of course, we could reduce the charge to 4 cents, 3 cents and so on down, until the extra charge for the lamps becomes so small that every customer would rather have them, but below 5 cents it is a question whether there would be much difference in the demand.

This question can also be handled in the same way that the New York, New Haven and Hartford Railroad reduced its fare to 2 cents a mile, by picking out different divisions and saying frankly to everybody that they reduced the rate in one division, and that as quickly as it became possible to get out the schedules and do the clerical work, etc., the other divisions would likewise be benefited. This resulted in no trouble, as the customers of the railroad easily recognized the necessity. In a similar way the central stations might pick out districts, or even classes of customers, and supply the "Gem" lamps free, say, first, to the churches, then to municipal buildings, then to residences, and so on uutil all customers were receiving them.

The "Hylo" lamp, while not in one sense a new illuminant, might properly be considered among them. The "Hylo" lamp saves the customer a great deal in places where he simply wants a dim light, but it costs the customer considerably more when he is using the full candle power. Hence, a customer who wants a little light for a considerable number of hours, and a good light for a short number of hours, gets it very much cheaper by the use of the "Hylo" lamp. The customer who now keeps in darkness when he would like a dim light, will get his dim light from the "Hylo," paying for that, and also paying an extra cost for the time when he wants a good light.

It is a question whether it would not be cheaper for the customer to put in two sockets side by side, one with a small 1 or 2-candle power light, and the other with an ordinary lamp of much better efficiency than fhe "Hylo." The extra cost of the second socket should not be over 75 cents or $1, for which 15 cents or 20 cents a year would be a fair allowance, and it would certainly seem as though this would be cheaper than to have the extra cost of the "Hylo."

All the new reflectors, such as holophanes, etc., are in a sense new illuminants. They result in giving more light where it is needed for the same amount of electricity, or the same light for a less amount of electricity; hence, a good reflector is just as good as an improvement in the efficiency of the lamp, and should have the same final result in the central station's business. In this case, however, it is somewhat simpler to have the customer supply the reflector, and this has resulted in the kind of difficulties that the central stations are having from the new light being handled by the customer so far as reflectors are concerned. If the central station had in the past always supplied the reflectors to the lamps, then any improvements in the reflectors would have been just as difficult for the central station to handle as the Tungsten, Nernst and other new lamps.

A very good summary of the difficulty that the central stations are having with the new illuminants is to call them growing pains. They are the difficulties that always arise when any new invention is made. If the customer supplies the lamps, as he does the reflectors, then the customer has the difficulties and the central station waits for the final result, which may be either more business or less business. If, however, the central station supplies the lamps, it must handle the question so as to give as small a temporary loss of income as is possible, so as to get the final result from the new illuminant as quickly as possible.

The central station must also handle the transfer from an old illuminant to a new, so as to avoid as far as possible any unnecessary scrapping of machinery. The central station should not adopt an improvement that will result in only 5 per cent. or 10 per cent. saving if at the end of a year or two it expects to find still another improvement has made the change of the year before a serious net loss on account of the very high depreciation.

The central station difficulties are what might be called detail questions, but it does not help us in handling these details to expatiate on the great future savings. Wise handling of the transfer by the central station will mean a considerable difference to the public, and this difference will be important, even if the savings by the new illuminants are much more important.

If anyone doubts the wisdom of having a central station try to handle all these difficulties of illumination and lamps and candle power, etc., all that is necessary is to ask such person to look at the results in countries where the central station confines itself solely to the supply of electricity, leaving the question of lamps and illumination to be handled by the individual customers.

Primary, Secondary and Working Standards of Light.

[A paper read by MR. EDWARD P. HYDE, at the Boston Meeting, Illuminating Engineering Society.]

We are living in an age of exact measurement. With what profound wonder would our forefathers have contemplated the marvelous precision of modern physical science. We compare resistances to parts in a million, we weigh weights to parts in a billion; indeed, if it were not for photometry and a few kindred sciences, I am afraid that the term "per cent.," which for so many years has been the common unit in expressing accuracy, would soon become obsolete in that sense.

What, we ask ourselves, is the cause of this tardy development of photometry? Is it because our instruments are insufficient or our standards inadequate, or is there some inherent difficulty that cannot be overcome? To be sure we shall always have the limitations of the human eye to contend with, because "light" by definition is subjective, but oftentimes the eye is made the scapegoat for faulty methods or inaccurate measurements. The accuracy of comparison of 2

luminous sources of the same color is well beyond that with which the intensity of either can be expressed in terms of our standards. The fault then lies ultimately with our standards.

It is not my intention in this paper to present to you a history of primary standards of light, or to make a study of the relative merits of the various standards in use at present. It is my purpose rather to ask your consideration of a few very practical questions in connection with the relationship of primary, secondary and working standards of light. By a "primary" standard is meant any standard that can be set up from written specifications, such as the Violle platinum standard, or the Hefner lamp or the Vernon-Harcourt pentane lamp. By a "secondary" standard is meant a standard which, though not reproducible, will remain constant after having once been calibrated. The well seasoned incandescent lamp is the best example of this. By a "working" standard is meant any lamp that is used as a standard in ordinary photometric measurements. It may be a secondary standard or even a primary one, but it is not necessarily either. Though the three classes of standards are quite separate in principle they overlap in practice.

There is one quality which all standards must possess in common. They must have a suitable color. This requirement is very indefinite, but it must needs be so. We cannot specify the actual spectral distribution, but we can exclude monochromatic sources. In other words, we can immediately eliminate some sources as being impracticable, whereas we cannot assign values relative to those which fall within the wide range of acceptability. In addition to this common property there are special properties which each class of standards must possess.

A primary standard is good or bad accordingly as it is or is not reproducible. Its fitness as a primary standard depends upon the degree of accuracy with which it can be reproduced. It is not necessary that it should remain constant over a long period of use; the time at which the measurements are to be made can be specified, as is done in the case of the Violle platinum standard. It is not even necessary that it should be particularly inexpensive or simple, as it is sufficient that it should be set up from time to time in one or several of the various national standardizing laboratories now in existence. The only absolutely necessary qualification of a primary standard is that, in case all the secondary and working standards should be destroyed, the unit could be re-established. Of course, if a lamp can at the same time serve as a primary standard and a secondary or working standard, it is the more valuable. If it is simple and inexpensive so much the better, but these are not necessary qualities of a primary standard.

In a secondary standard we desire other qualities. These are best seen by keeping in mind an example - the well-seasoned incandescent lamp. A secondary standard need not be reproducible we cannot make two incandescent lamps exactly alike; but it must remain constant after having once been calibrated in terms of the primary standard. It should be portable, simple and inexpensive. Every standardizing laboratory should have a number of secondary standards against which to measure the working standards of lamp manufacturers and testing laboratories.

The working standards should be adapted to the particular kind of testing in which they are to be used. In testing incandescent lamps we want as working standards other incandescent lamps; in testing gas or oil we want flame standards. Working standards should be portable, simple and inexpensive, easy to manipulate and of suitable intensity, but they need not be reproducible. Having been standardized in terms of secondary standards, they should remain constant over a reasonably long period before having to be recalibrated or replaced.

With this brief statement of the requirements of primary, secondary and working standards of light, let us inquire into the present conditions regarding these three classes of standards, First, is there a satisfactory primary standard of light? I think you will all agree with me that there is not. Many such standards have been proposed from time to time, and at present there are three or four such standards in actual use. This last fact in itself indicates that there is no one standard sufficiently superior to the others to warrant its general adoption. And if we look over the tables of relative values of these different standards and compare the values found at one laboratory with those found at another, or those obtained in recent determinations with those accepted as the best of previous determinations, it is evident that there is an uncertainty in the ratios well beyond the limit of the error of measurement.

The situation with regard to secondary standards is quite different. It is generally conceded that the well-seasoned incandescent lamp meets every requirement of a secondary standard of light. The objection occasionally raised, that it changes with the time of burning, is not in my opinion as important as the changes which seem to take place at times when the lamp is stored away. A 4-watt per candle lamp, if properly seasoned, will not change appreciably; *i. e.*, more than 2 or 3 parts in a 1,000 in 50 or 75 hours' continuous burning. Since it only requires several minutes to measure an incandescent lamp, the standard lamp could be measured 500 or 1,000 times before it would change appreciably in intensity. Since at the Bureau of Standards there are incandescent lamp secondary standards that are only used once or twice a year, it is evident that if only the change in candle power due to burning is to be reckoned with, the unit, in terms of which the secondary standards are expressed, could be maintained constant to within 2 or 3 parts in 1,000 for several hundred years.

On the other hand there seem to be much larger changes in the lamps from time to time while the lamps are not burning. Occasionally a lamp develops a bad vacuum; at other times a change in resistance is noticed, indicating probably an altered contact resistance between the filament and the leading-in wires. But apart from these changes in candle power, which are accompanied by changes in the electrical properties of the lamps and which can probably be explained, there are apparent changes in intensity which are just over the limit of observational error, and for which we can offer no explanation. In determining the relative values of a number of incandescent lamps that have been inter-compared before, one of the lamps may seem to be high or low in intensity, with respect to the mean of the remaining lamps, by ½ per cent. or more. I do not mean that a single observer with one set of readings finds the lamp off by that amount - observational error might possibly account for that; but the mean of a number of sets by one observer agrees with the mean of a number of sets by another observer, in giving to that lamp a value somewhat different from that which it previously had. In another set of measurements, some time later, the lamp may come back to its original value. Whether these apparent changes are due to slight differences in the conditions of measurement at different times, or whether they are real changes in the lamps, it would be premature to say at present. They are small, however, and if a number of lamps are used, the mean value should remain sensibly constant over a long period.

The well-seasoned incandescent lamp is also an entirely satisfactory working standard in the photometry of electric lamps, but it is not suitable for use in gas photometry. It requires electric power to operate it and electrical measuring instruments to control it, and these are usually not available, particularly in small gas plants; but, apart from its inconvenience, it is unsatisfactory. The intensity of a gas flame is a function of the atmospheric conditions, and it would be practicable to correct all measurements to standard conditions, as that would involve determinations, not only of water vapor and carbon dioxide, but also of the proportion of oxygen present in the atmosphere. In supplying gas. however, it is desirable for the manufacturer to state that the candle power of the gas furnished under normal atmospheric conditions would be up to the requirement. The way in which to determine this, without actually making the corrections, is to have as a working standard a lamp that is affected by the atmospheric conditions in the same way and to the same amount as the gas under test. If the intensity of the standard lamp under normal conditions is known, the candle power of the gas under normal conditions is obtained immediately, by direct comparison with the standard lamp, independent of the atmospheric condition of the photometer room, provided it is uniform throughout the room.

The consensus of opinion among gas engineers is certainly that the working standard for gas photometry should be a flame standard. There seems to be less unanimity, however, in regard to what flame standard should be used. Candles are still used to some extent in the United States and abroad, but recently there has been considerable advancement both in this country and in England in the adoption of the Harcourt 10-candle power pentane lamp. In Germany the Hefner lamp is used now to a great extent in gas photometry, I believe, and in France the Carcel lamp continues to be used almost exclusively. But although flame standards have been and still are used in gas photometry, I do not know of any investigation of the relative influence of atmospheric changes on the gas and the standard lamp. It is scarcely justifiable to assume that the coefficients are the same for two such flames as the pentane flame and the gas flame, which are controlled in entirely different ways. The pentane lamp is adjusted for flame height, whereas in much ot the gas work the flame of the batswing burner is adjusted to a definite rate of consumption of gas by

weight. Recently, in cooperation with the United Gas Improvement Company, of Philadelphia, the Bureau of Standards made some experiments along this line in one of the Company's gas testing photometer rooms in Philadelphia. Although these preliminary experiments were not carried far enough to warrant any very definite conclusions, they indicated that the two flames, the pentane and the gas, are affected in the same way, to approximately the same extent, by changes in the atmosphere. Since differences of 8 or 10 per cent. in the intensity of the standard lamp may readily occur under normal working conditions, it is evident that if results of any accuracy are sought it is not sufficient that the atmospheric conditions affect the standard flame and the gas flame in the same direction; the coefficients of change for the two should be very nearly the same.

Another interesting fact in connection with the working standards in gas photometry is that, with the possible exception of the Carcel lamp which, I believe, has been calibrated in terms of the Violle standard, all of the lamps used as working standards are at the same time primary standards. In the photometry of electric lamps the seasoned incandescent lamp soon came to be used as the working standard, since the primary flame standards were not convenient; but in the photometry of gas, since a flame standard was desired, the primary standards came to be used as the working standards. Although this is a logical result, it is questionable whether it is the most satisfactory one.

Is it not possible that a cheap and portable lamp which would remain constant in intensity after having been calibrated might be found which would be more convenient and more easily manipulated than the Harcourt pentane lamp, for example? It does not follow that the lamp which best satisfies the requirements of both a primary and a working standard will satisfy the requirements of a working standard alone better than any other lamp. In other words, the lamp which is best, with respect to both constancy and reproducibility, need not be the most constant lamp, if reproducibility is eliminated. With authoritative testing laboratories available, where secondary standards are maintained, it is no longer necessary that the primary standards should be used in industrial photometry.

I have no such lamp to suggest as a working standard for gas, and it is possible that none can be found; but I think it is well to divorce the functions of the two kinds of standards. Reproducibility is the chief requirement for a primary standard, and constancy with burning is only a convenience. With the working standard reproducibility is of no consequence; the lamp, however, should remain constant while burning, thus maintaining the candle power assigned to it on calibration. If the lamp which is the most reproducible is the most constant and convenient, then use it as a working standard, but do not confine the search for a working standard to those lamps which are reproducible.

The use of a primary standard as a working standard may, however, lead to a confusion of units between the gas and electric industries. This is exemplified by the situation in our own country at present. Both in the photometry of gas and of electric lamps the intention was to use the British parliamentary candle. The American Institute of Electrical Engineers recommends obtaining the candle through the Hefner by the use of the ratio one Hefner equals 0.88 candle, which was supposed to be the mean value of the best determinations of that ratio. In gas photometry the sperm candle, or more generally in recent years the Harcourt pentane lamp has been used. It is definitely known now that the candle obtained through the pentane lamp does not bear to the Hefner candle the ratio of 1 to 0.88. From comparisons through electric lamps measured at the National Physical Laboratory in England and at the Physikalische-Technische-Reichsanstalt in Germany, the above ratio is found to be in error by 2 per cent. From direct comparisons of Hefner and Harcourt pentane lamps the ratio appears to be in error by 4 or 5 per cent. If, now, both the gas and electric lighting industries adopted the same unit, which could be maintained at a national laboratory, and in terms of which working standards for both gas and electric lamps could be calibrated, "candle power" would have a single significance throughout the entire country.

The final step would be to agree with other civilized countries on the value of the unit adopted so that we might have in photometry, as in most other branches of physical science, an international unit. Although the German unit is so different from the others as to offer considerable difficulty to the realization of this plan, the units of England, France and the United States are sufficiently close to warrant a compromise. This compromise would not entail the abolishment of the present standards; it would merely necessitate assigning to the standards different numerical values. Thus the Carcel would no longer be 9.6 bougies decimales, but 9.5 or 9.4 international candles. Each country could maintain the unit through whatever standards it chose, primary or secondary, but by frequent inter-comparisons among the various countries, the unit would be maintained. Let the search for a suitable primary standard be continued, and may the time soon come when there shall not only be an international unit, but an international standard which shall take rank with the other international standards of modern physical science.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

On August 1st the Kansas City, Missouri, Gas Company paid into the city treasury the sum of $3,786.32, which sum represented 2 per cent. on its gross income from the distribution of natural gas for the first half of 1907.

The Gas Machinery Company, of Cleveland, O., has been awarded the contract for the construction of the new oil gas plant to be erected in Marshfield, Ore., by the Coos Bay Gas and Electric Company. This contract was closed by Mr. E. H. Corbett, of the Hallidie Machinery Company, who represent the Gas Machinery Company on the Coast.

Colonel De Grange, Vice-President of the New Orleans Gas Light Company, and Mr. T. D. Miller, its General Manager, have convinced the owners of the Company that it would be a good thing to again cut the gas rate there. The announcement will be made some time in September, and in all probability the net figure will be fixed at $1.10 per 1,000.

"L. A. W." writing from Boston, Mass., under date of the 3d inst., inclosed the following: "One of the features of the dedication of the the Cambridge bridge was the gas illumination of the bridge itself. This is accomplished by 114 incandescent gas lamps, each carrying 2 burners, and giving about 150-candle power. The lamps are about 40 feet apart and set abreast. With this arrangement the bridge is one of the best lighted in Boston. The lamp posts, which are highly ornamental, were designed by Wheelwright & Hayden, and are in keeping with their surroundings."

At the annual meeting of the Fitchburg (Mass.) Gas and Electric Light Company the officers elected were: Directors, George H. Crocker, Charles E. Ware, F. B. Shepley, H. I. Page, G. R. Wallace, H. I. Wallace and H. F. Coggshall; President, H. I. Wallace; Treasurer and General Manager, Henry F. Coggshall. The Company's business for the twelvemonth made the most profitable showing in its history. Well! Perhaps Mr. Coggshall is not attending to business?

When the betterments on the works of the Cadillac (Mich.) Gas Light Company are completed the capacity thereof will have been increased one-third.

The Board of Managers of the County Jail, of Davenport, Ia., decided last month to equip the kitchens of the institution with gas ranges.

Mr. Carl Steinwedell has been appointed General Manager of the Columbus (O.) Gas and Fuel Company, and in fact is right on the job. The Colonel's other son will have a lot to do in Columbus, not the least of which work will be on the distribution system, which in the "altogether" natural gas regime was badly neglected. There is not a doubt in the world, however, that he will be up to the task in every particular.

The New Haven (Conn.) Gas Light Company has purchased from the Mersick estate the premises on Crown street known as the Mersick Block. The plot and building adjoin the office property owned by the Company.

The capital stock of the Passadena (Cal.) Consolidated Gas Company has been increased from $250,000 to $1,000,000. Mr. W. B. Cline still retains an active interest in the Company. In fact it is to his watchfulness and splendid capacity for business that the Company is largely indebted for its present high commercial standing.

In a circular letter recently sent out to the shareholders, by Mr. Norman G. Kenan, President of the Cincinnati Gas and Electric Company, the following percentages of increase in the Company's trading were shown:

Class of Service.	Increase, No.	Increase, per Cent.
Gas services installed.....	446	23.53
Gas ranges sold	3,623	86.41
Net increase in electric service connected; 16-c.p. equivalent	7,583	19.25
Gas meters connected up.....	3,871	29.25
Electric meters "	544	25.89
" electric current delivered to consumers	..	18.81
Gas delivered to consumers	..	12.13

AT the session of the General Council, of Louisville, Ky., for organization, the gentlemen elected to represent the city on the Board of Directors of the Louisville Gas Company were Messrs. W. J. Abram, George Gaulbert, W. H. Edinger and George M. Boone.

MR. T. R. BENSON, writing from Denver, Col., under date of the 2d inst., forwards the following: "The second class of the Henry L. Doherty School of Gas and Electric Practice, conducted under the direction of Mr. Doherty by the Denver Gas and Electric Company, is now well started in the course that will give the members two years of instruction in the practical branches of the industry. This year's class numbers 24 young men who finished engineering courses in some of the leading colleges and universities of the United States. They were chosen from many hundreds of graduates of the institutions of the country, and, when they are through with the practical training provided by the Denver Company, will be fitted for responsible positions here or elsewhere. Last year marked the founding of this school of practice by Mr. Doherty, who had previously given much time and taken great pains to develop efficient young men by giving them the opportunity of learning through a connection with one of his numerous properties. As the Denver Company has become by common consent the training school for all branches of the work, the school naturally was established here. So great is the demand for efficient men trained along the modern lines brought into play so successfully by Mr. Doherty, that he took this method of developing efficient assistants as the best and quickest way in which to obtain material that is constantly in demand in perfecting his organization of properties throughout the country."

IN the adjourned hearing before the Massachusetts Board of Gas and Electric Light Commissioners, in the case of the city's demand for lower rates, from the Fall River Gas Works Company, the star witness for the city was Mr. Alton D. Adams. Our correspondent in noting the testimony on the afternoon of the first day says: "The hearing began at 2:25, with Mr. Adams giving further extracts from various authorities upon the matter of pressure, which in the main had been advanced by English engineers. Asked by the Mayor regarding fast meters, Adams said that in almost every instance false registration of gas was due to improper construction of the meter. The Mayor asked Mr. Adams what would be the proper thing to do in order to furnish a reasonable supply of gas. Mr. Adams said either to change the distributing system of pipes, or arrange the system on the low pressure plan. Another means would be to establish pressure regulators at each meter. This plan would be better for the Company and better for the consumer. The expense of such regulators, he said, should be borne by the Company. The Mayor then informed the Chairman of the Commission that he did not desire to close his side of the case, but would like to have a chance later on to present the testimony of consumers. He submitted some gas bills to the Commission as evidence.

"There was some discussion between Chairman Barker and the Mayor in regard to just what complaint the city had to bring out against the Company, whether it was excessive price or excessive pressure. In the petition, the matter of price was given first mention, but all during the hearing stress had been laid upon the matter of excessive pressure. The Mayor said he was willing to close the hearing upon the question of excessive pressure, but intimated that the matter of excessive price would be taken up at a later date with the Commission, unless the Gas Company did something in regard to that part of the city's grievance against the Company. Mr. Adams was then submitted to the cross-examination of Lawyer Hunt. In answer to questions from the lawyer he said he graduated from Lawrence Scientific School, in 1897, after a 2 years' course in engineering. He received the degree of bachelor of science. He could not tell which course he took. He never had been employed in the manufacture of gas. The studies he pursued at the scientific school touched upon gas engineering only in an indirect way. He never had been engaged in the distribution of gas. His connection with gas to any extent had been since 1900, and consisted of the inspection of gas plants and the study of the operation of gas plants. He never had installed any mains for the purpose of conveying gas, but he had installed mains of other kinds. He said his inspection of the local pressure ran back to 1903. His knowledge of the pressure had been learned from an inspection of the charts of the gas company. A number of other questions in regard to pressure were propounded, but the answers secured were not very definite. Lawyer Hunt concluded his examination at 3:25, and after a short consultation between the commissioners and the lawyers, it was decided to adjourn the hearing until Wednesday, September 18."

"T.," WRITING from Berlin, Wis., under date of the 5th inst., says: "You will find inclosed a clipping giving an account of an accident which happened during the last week of July, which goes to show that some gas men are growing too careless, in a sense that is harmful to themselves and harmful to the business as a whole. We are all liable to make mistakes, of course; but this sad affair should be a warning to all, and the sooner the looking for leaks with a naked light is altogether stopped, the better it will be for all concerned."

THE clipping inclosed by our correspondent narrates that some days ago Mr. Henry Ayers, Superintendent of the works of the Middletown (O.) Gas Light Company, visited a house the occupants of which had complained that the cellar smelled of gas. He entered the cellar carrying a lantern. A violent explosion ensued, which caused injuries to him of a gravity sufficient to cause his death a day or so afterward.

HERE is one on us, and the good-natured complaint is printed in full, as our contribution towards helping on the good work:

WYANDOTTE GAS COMPANY,
KANSAS CITY, KAS., July 29th, 1907.

To the Editors AMERICAN GAS LIGHT JOURNAL: In your issue of July 29th is an article which reads as follows: "The last payment to the City Treasurer by the Wyandotte Gas Company, which supplies gas to the west side of Kansas City, Missouri, was $4,988.46, which sum represents 2 per cent. of the Company's gross earnings for the first half of 1907." This is a very nice article, indeed, but for our sakes we are very glad that the AMERICAN GAS LIGHT JOURNAL does not have a very wide circulation in the city of Kansas City, Kas., as there has been a great strife on for a long while as to the different sides of the two cases: Namely, Kansas City, Kas., and Kansas City, Mo. Kansas City, Kas., is a city of something over 100,000 population. It is in Kansas, not Missouri, and is neither west side, east side, nor any other side of Kansas City, Mo. The Wyandotte Gas Company supplies gas to Kansas City, Kas., independent entirely of the Kansas City (Mo.) Gas Company on the Kansas City, Mo., side. I write this simply to call your attention to this article, and wish to state that Kansas City, Kas., gets the worst of this argument in many ways, and as the citizens of Kansas City, Kas., are trying to establish some individuality, I take this means of helping the good work along. —Very truly yours, W. H. MCKENZIE, Secretary."

AND it here behooves us to say, as is blazoned on the banners of the great State of Ar-Kansas: "*Regnat populus;* also, *regnant populi!*" The people make the place.

A CORRESPONDENT forwards the following, dated Haverhill, Mass., the 3d inst.: "Mayor Wood is a diplomat, which fact has been thrice exemplified since the City Council made a contract for the gas and naphtha lights with the Haverhill Gas Company. The latest example of his diplomacy occurred this week when he prevailed upon New England District Manager Edward Garsia, of Boston, to continue the Welsbach street lighting service for another month. Last June when the Welsbach contract expired the Haverhill Gas Company submitted figures and its prices surprised the Welsbach people. The latter concern at first decided to take out its fixtures and posts, but the Mayor argued that this step might injure the concern in other places. The result was that the Company kept its service on until July 1, as it was conceded that General Manager P. J. Nevins, of the Haverhill Gas Company, would be unable to replace the lights in such a short time. The Welsbach Company next wanted an advance in its price for the month of July, and while the Haverhill Gas Company offered to pay a liberal rental for the Welsbach equipment, the offer was rejected. The Mayor then pointed out that it was the people who would suffer because of the lack of street lights and a second time the Welsbach Company gave in. This week the Welsbach Company had all plans arranged to take out its posts and equipment, but the Mayor, after a conference with District Manager Garsia, prevailed upon him to continue the service for another month and by that time the Haverhill Gas Company will be ready to take charge of the service, as it has been handicapped by the delay in securing its equipment that has been hung up by the railroads. Under the new contract Haverhill will pay only $14 for its gas lights and $21 for naphtha lights, as compared with $18.50 and $25, which it has been paying. The Haverhill Gas Company would have been prepared within two weeks to begin its service, and as the Welsbach Company planned to use two days in removing its posts and equipment, Mayor wood has been complimented for his diplomacy in prevailing upon the Welsbach to continue its service for another month." To which might be added that the Welsbach Company seldom does things by halves.

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, AUGUST 12, 1907.

The Market for Gas Securities.

There isn't any market for Consolidated gas. Why, we know not. Possibly it is because the Standard Oil Company was fined something over $29,000,000 last week, and the business between the two Companies is rather close. What do you think of that for "reasoning?" The opening quotation for Consolidated to-day (Friday) was 112 to 115.

Strange to say, Brooklyn Union is "up;" that is for Brooklyn Union. It is 110 to 115. We might better have said that it is not "down!" Peoples, of Chicago, resisted the recent slump about as well as anything on the list. It should be 20 points higher than it is.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

AUGUST 12.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	112	115
Central Union Gas Co.—				
1st 5's, due 1972, J & J	3,000,000	1,000	101	104
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	..	105
Mutual	3,500,000	100	190	225
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	98	100
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p.ct.	1,000,000	..	98	104
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	101	102
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	108	111
Con. 5's, due 1945, J. & J.	1,500,000	..	104	110
Standard	5,000,000	100	140	160
Preferred	5,000,000	100	155	175
1st Mtg. 5's, due 1930, M. & N	1,500,000	1,000	104	108
The Brooklyn Union	15,000,000	1,000	110	115
1st Con. 5's, due 1948, M. & N	15,000,000		100¾	102
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Bay State	50,000,000	50	¼	⅜
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	65
" 1st Mtg. 5's	500,000	1,000	95	100
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47¾	50
Buffalo City Gas Co.	5,500,000	100	9	10
" " Bonds, 5's	5,250,000	1,000	75	80
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	106¾
Cincinnat Gas and Electric Co.	29,500,000	100	97	97½
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	90	..
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	87	88
Preferred	3,096,500	100	107½	108
Consumers, Toronto	2,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	..	90
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	950,000	1,000	92	95
Bonds	75,000	..	..	100
Detroit City Gas Co	5,000,000	50	..	50
" Prior Lien 5's	4,618,000	1,000	..	98
Detroit Gas Co., 5's	381,000	1,000	75	80
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,235,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	110	112
Bonds, 5's	10,500,000	..	107½	108¾
Indianapolis	2,000,000	..	60	70
" Bonds, 5's	2,650,000	..	104½	105
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	86
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	..	66
Preferred	2,500,000	100	95	110
Bonds	10,000,000	1,000	104	104¼
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	143	145
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	106	108¾
" 6 per cent. scrip, due 1910	100,000	25	26	33
Massachusetts Gas Companies of Boston	25,000,000	100	54½	55
Preferred	25,000,000	100	82	83
Montreal, Canada	2,000,000	100	218	218¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	6,000,000	..	137	138
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	89	89½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	30,100,000	1,000	..	..
" 2d "	2,500,000	1,000	104	..
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	104¼	105¼
San Francisco, Cal.	15,800,000	100	..	..
St. Joseph Gas Co. 1st Mtg. 5's	751,000	1,000	92	..
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	850,000	1,000	113	116
Extension, 6's	600,000	1,000	112¾	115
General Mortgage, 5's	2,465,000	1,000	96¼	..
Syracuse, N. Y.	1,975,000	100	50	55
Bonds	2,047 000	1,000	102	..
Washington, D. C	2,500,000	20	375	380
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	..	..	..
Wilmington, Del.	600,000	50	220	..

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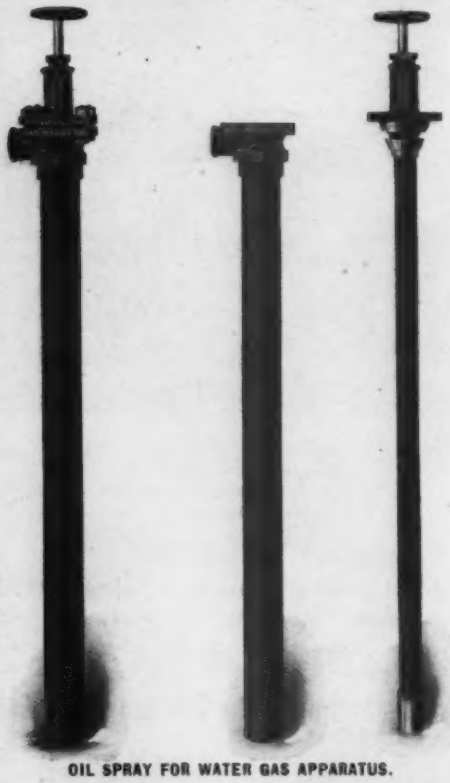

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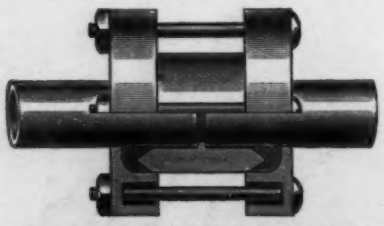
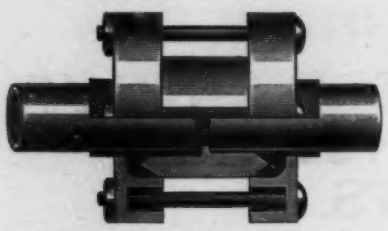
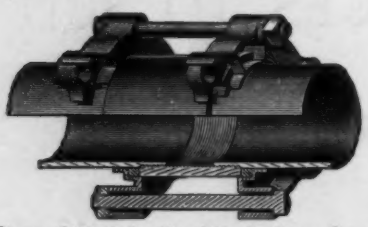


Regular Coupling, Style 1, for Plain End Wrought Iron Pipe.



Insulating Coupling, Style 5, for Plain End Wrought Iron Pipe,



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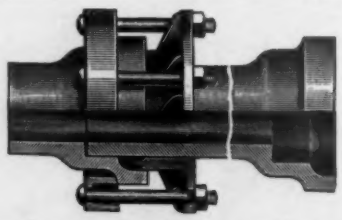
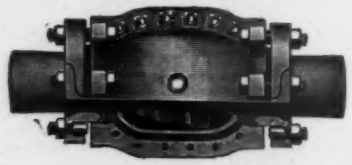
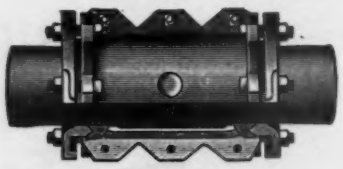


Coupling, Style 9, for Special Style Cast Iron Pipe.



Split Sleeve for Repairing Broken Bell on Cast Iron Pipe.



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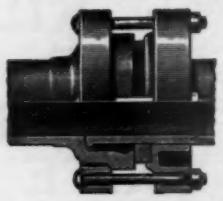

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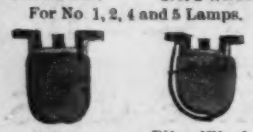
For No 1, 2, 4 and 5 Lamps.



Bijou. Bijou Wired.
For No. 3 (Bijou) Lamp.

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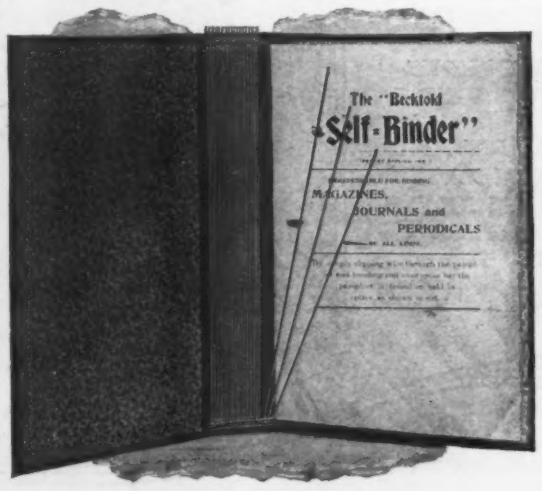

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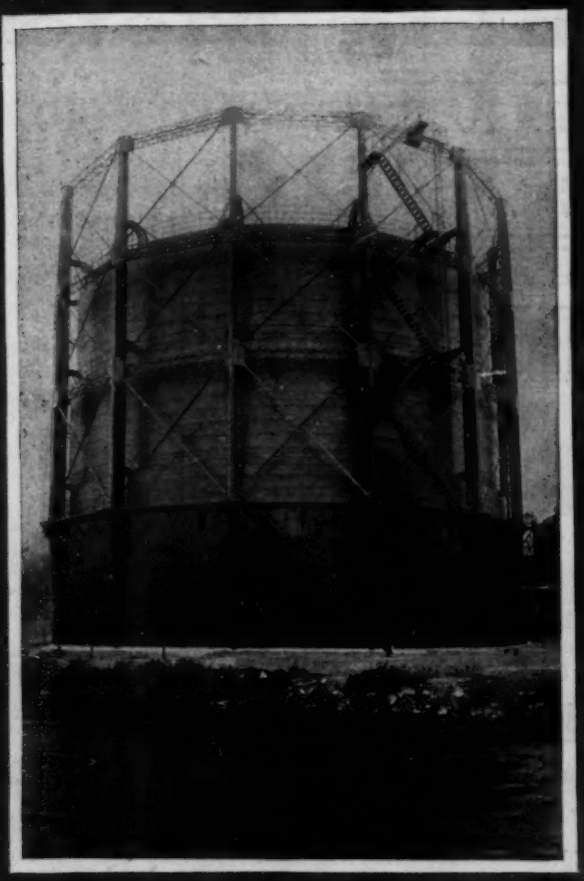

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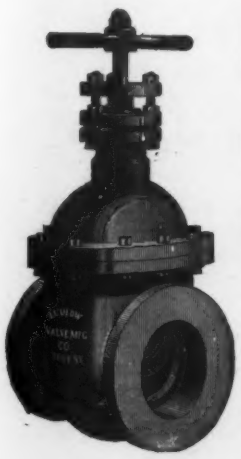

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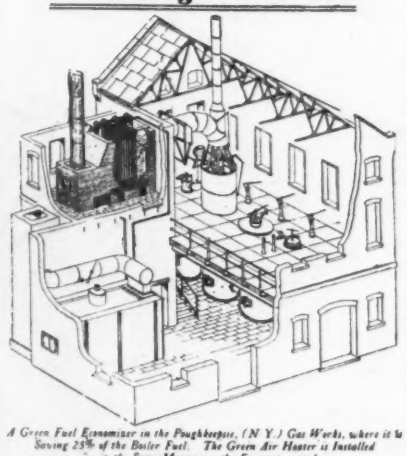

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The stack valve gases from a gas generator usually escape at from 1,500° to 1,800° F. After passing them through the Green Air Heater to heat the blast they will still have a temperature of 800° F., which is higher than the usual temperature of flue gases from boilers. They may, therefore, still be used to heat water for the boiler, and will thus save 20 per cent. of the boiler coal. On this basis, a plant making 5,000,000 cubic feet of gas per month will save nearly $2,500 per year on a total investment of $3,500.

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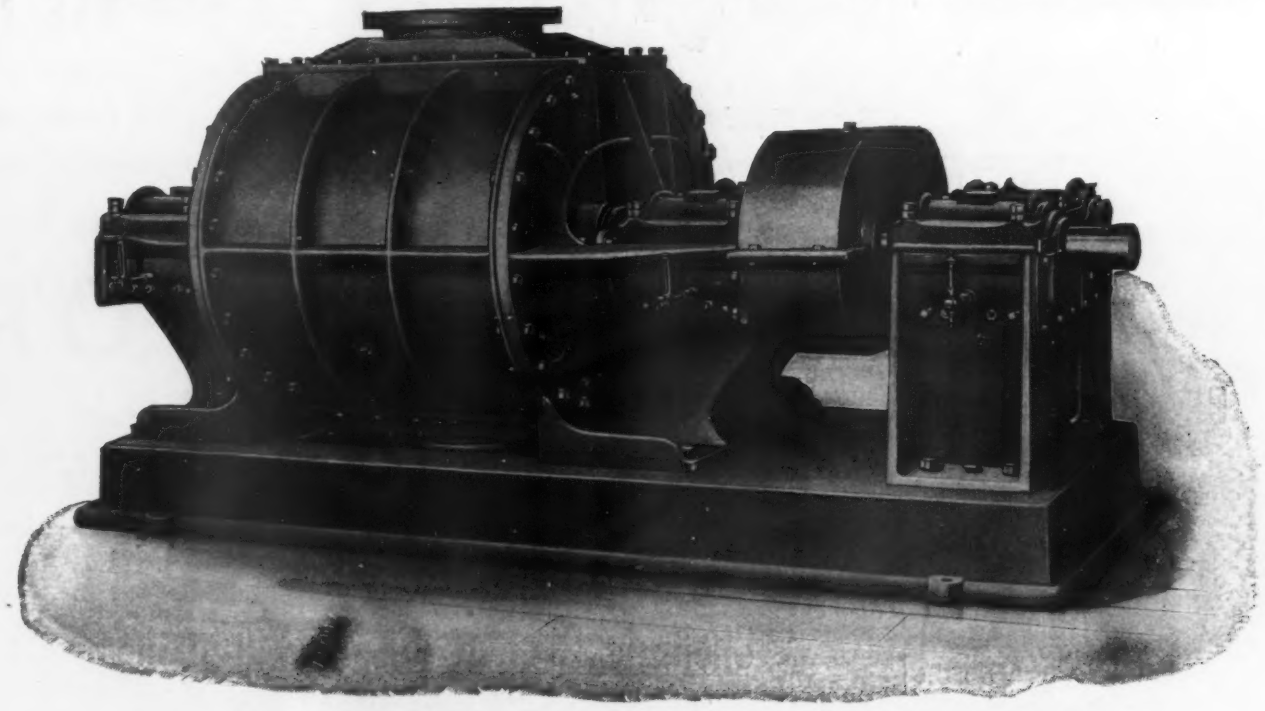

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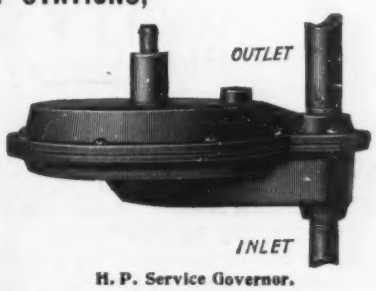

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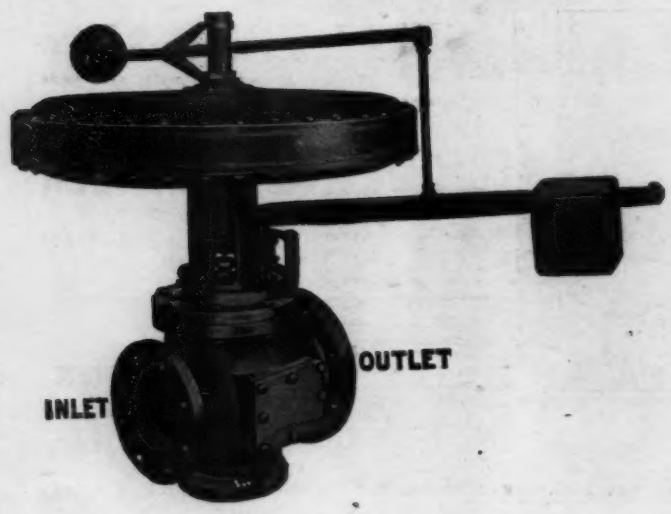

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PUBLIC LIGHTING TABLE.

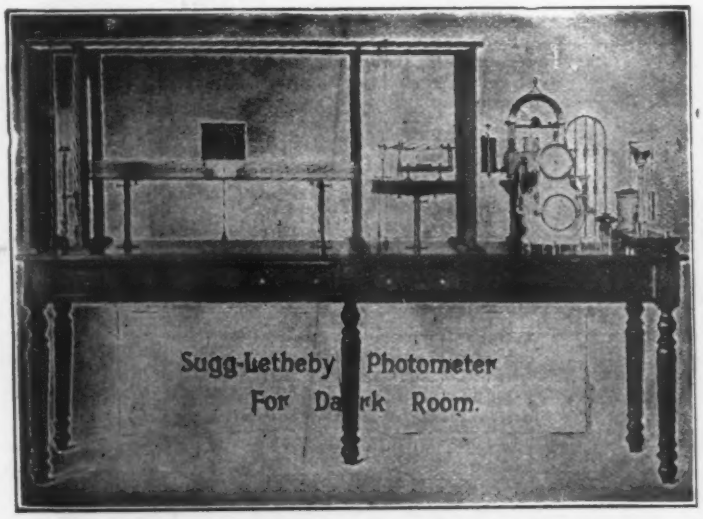
AUGUST, 1907.

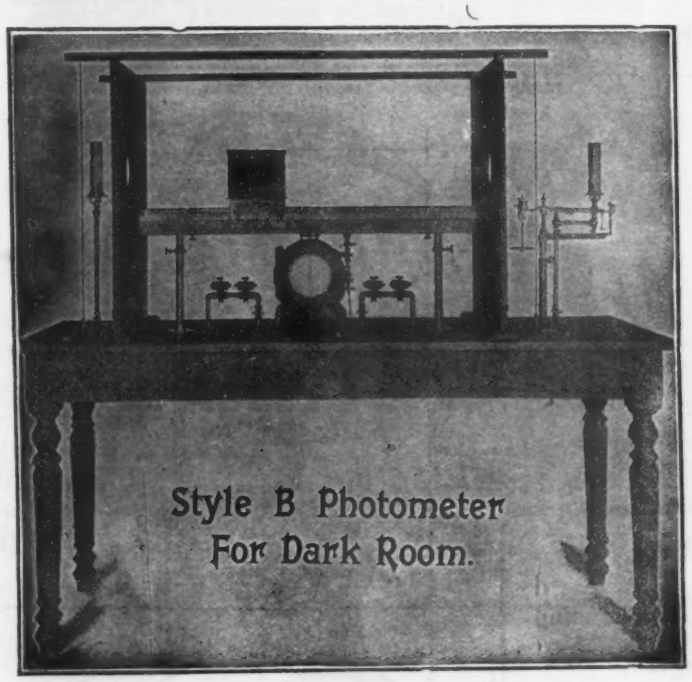
Day of Week.	Table No. 1. FOLLOWING THE MOON. Date.	Light.	Extinguish.
Thu.	1	7.50 PM	12.50 AM
Fri.	2	7.50	1.30
Sat.	3	7.50	2.00
Sun.	4	7.40	2.40
Mon.	5	7.40	4.00
Tue.	6	7.40	4.00
Wed.	7	7.40	4.00
Thu.	8	7.40 NM	4.00
Fri.	9	7.40	4.00
Sat.	10	7.40	4.00
Sun.	11	7.30	4.10
Mon.	12	7.30	4.10
Tue.	13	8.40	4.10
Wed.	14	9.00	4.10
Thu.	15	9.40	4.10
Fri.	16	10.10 FQ	4.10
Sat.	17	10.50	4.10
Sun.	18	11.40	4.20
Mon.	19	12.40 AM	4.20
Tue.	20	1.40	4.20
Wed.	21	2.50	4.20
Thu.	22	No L.	No L.
Fri.	23	No L. FM	No L.
Sat.	24	No L.	No L.
Sun.	25	7.10 PM	9.20 PM
Mon.	26	7.10	9.50
Tue.	27	7.10	10.20
Wed.	28	7.10	10.50
Thu.	29	7.10	11.30
Fri.	30	7.10 LQ	12.00
Sat.	31	7.10	12.40 AM

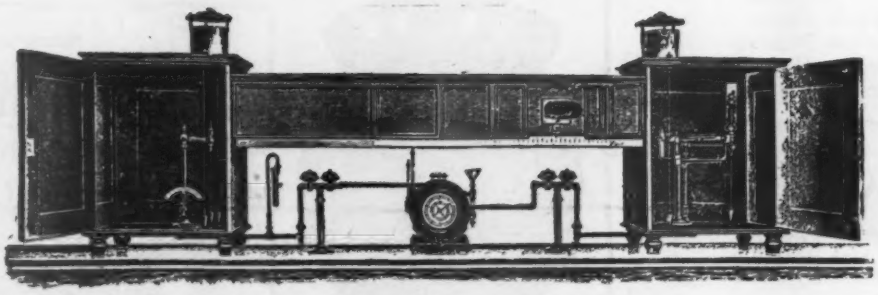
TOTAL HOURS DURING 1907.

By Table No. 1.

	Hrs. Min.
January	211.10
February	193.40
March	182.10
April	167.00
May	157.00
June	145.30
July	151.50
August	162.30
September	175.30
October	202.40
November	209.30
December	231.50
Total, yr.	2190.20







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

AUGUST, 1907.

Day of Week.	Table No. 2. NEW YORK CITY. All Night Lighting. Date.	Light	Extinguish.
		P. M.	A.M.
Thu.	1	7.10	3.30
Fri.	2	7.10	3.30
Sat.	3	7.10	3.30
Sun.	4	7.10	3.30
Mon.	5	7.10	3.30
Tue.	6	7.10	3.45
Wed.	7	7.10	3.45
Thu.	8	7.10	3.45
Fri.	9	7.10	3.45
Sat.	10	7.10	3.45
Sun.	11	7.10	3.45
Mon.	12	7.10	3.45
Tue.	13	6 55	4 00
Wed.	14	6.55	4.00
Thu.	15	6 55	4.00
Fri.	16	6 55	4.00
Sat.	17	6.55	4.00
Sun.	18	6.55	4.00
Mon.	19	6 55	4 00
Tue.	20	6 45	4.10
Wed.	21	6 45	4.10
Thu.	22	6.45	4.10
Fri.	23	6.45	4.10
Sat.	24	6.45	4.10
Sun.	25	6.45	4.10
Mon.	26	6 45	4.10
Tue.	27	6 30	4.20
Wed.	28	6.30	4.20
Thu.	29	6.30	4.20
Fri.	30	6.30	4.20
Sat.	31	6.30	4.20

TOTAL HOURS DURING 1907.

By Table No. 2.

	Hrs. Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

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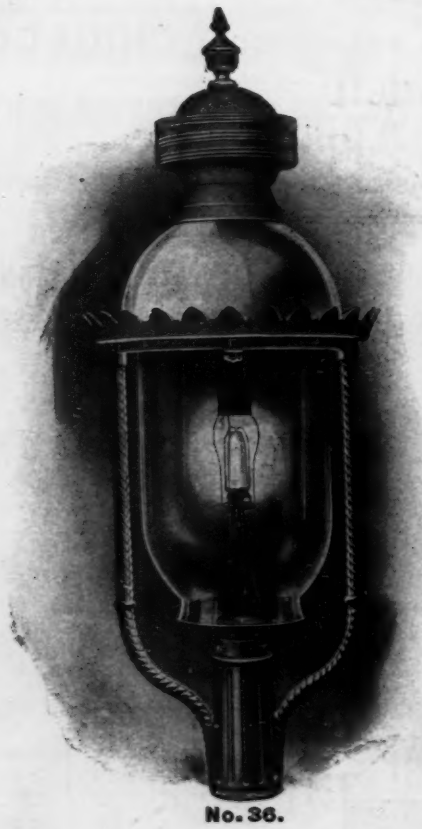
....OF AMERICA....



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Uniformly SUCCESSFUL in 150 Cities and Towns.

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Perfect Combustion.
Lowest Gas Consumption.
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Will Fit Any Fixture.
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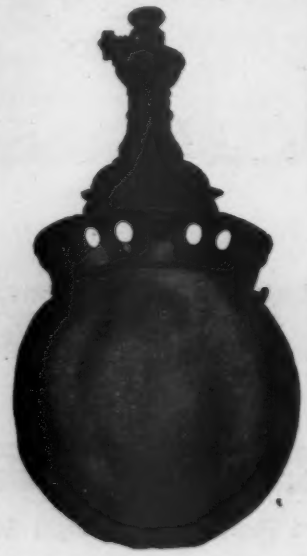

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Jenkintown, Pa. (2d contract).
Coney Island, N. Y.
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Syracuse, N. Y. (2d contract).
Atlanta, Ga. (3d contract).
Holyoke, Mass.
Peoria, Ills.
Schnectady, N. Y. (2d contract).
Danbury, Conn.
Galveston, Tex. (2d contract).
Quebec, Canada.
Indianapolis, Ind. (2d contract).
Bessemer, Ala.
Waterbury, Conn. (5th contract).
Sioux Falls, S. D. (3d contract).
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TOTAL SETS INSTALLED TO JULY 1, 1907, ... 34
TOTAL SETS TO DATE, ... 668
TOTAL DAILY CAPACITY, ... 541,655,000 cu. ft.

Tar Extractors for Carburetted Water Gas.
Photometrical Apparatus.
Gas Analysis Apparatus.
Recording Gauges.
Straight Standpipe System for Coal Gas Retorts.
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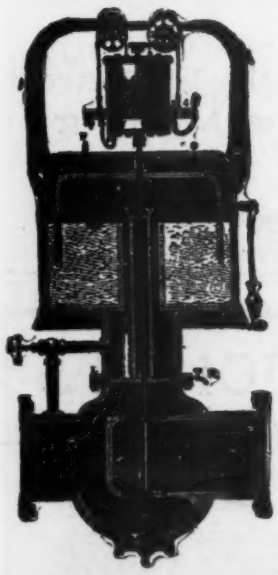

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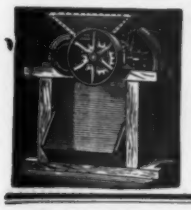

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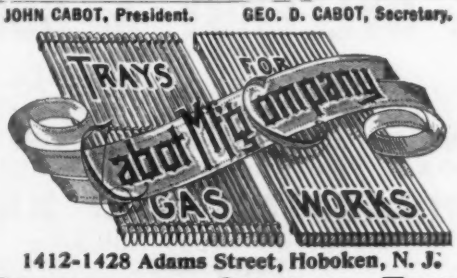

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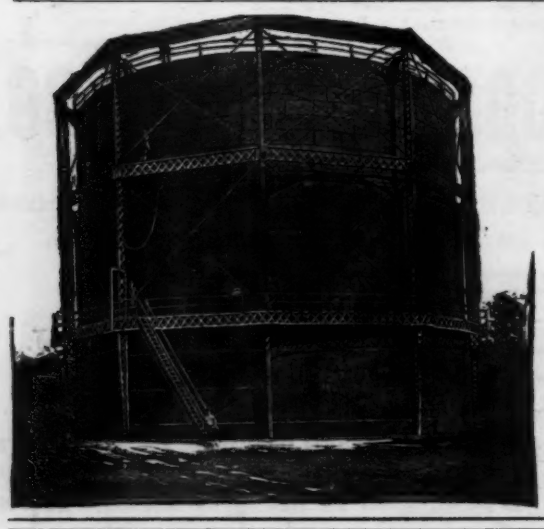

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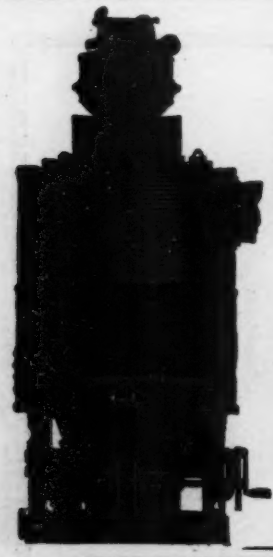

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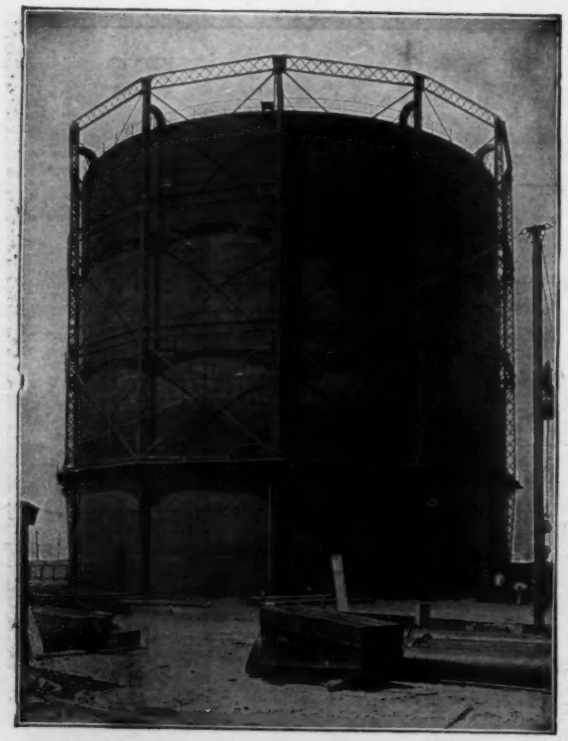

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